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U.S. PATENT APPLICATION

OF

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FOR

DRILLING FLUIDS CONTAINING AN ALKALI METAL FORMATE

DRILLING FLUIDS CONTAINING AN ALKALI METAL FORMATE

This application claims the benefit under 35 U.S.C. §119(e) of prior U.S. Provisional Patent Application No. 60/268,520 filed February 14, 2001, which is incorporated in its entirety by reference herein.

BACKGROUND OF THE INVENTION

The present invention relates to the drilling industry and more particularly relates to drilling fluids used in drilling, such as the drilling of a well for the recovery of hydrocarbons or other materials.

In drilling operations, such as the drilling that occurs in oil field operations, drilling fluids are designed/formulated to serve several functions. These functions include acting as a lubricant to the drill bit to reduce wear and friction during drilling and also to seal the formation surface by forming a filter cake. Currently, in the industry, both oil-based muds (OBMs) and water based muds (WBMs) are typically used. More commonly, synthetic based muds (SBMs) are also used in drilling operations. In the drilling fluid, agents for lubrication are present as well as weighting materials in order to achieve a density that typically produces a pressure greater than the surrounding pressure in the well bore. Furthermore, the drilling fluid will also contain a sealing or fluid loss agent, such as calcium carbonate for pore bridging especially polysaccharides and other polymers, in order to form the filter cake on the formation surface of the well bore. In addition, when the drilling fluids are used during drilling, the drilling fluid will also contain drilling fines, such as shale and sandstone fines. During the drilling operations and afterwards, the filter cake seals the formation surface of the well bore so that the well bore can be completely formed without any leakage from the formation surface into the well bore and/or without any leakage of the drilling fluids into the formation surface. While the filter cake is beneficial for these reasons, once the drilling is completed, and the recovery of hydrocarbons is the next step, the filter cake can act as a severe impediment to the recovery of hydrocarbons. For instance, the filter cake can prevent the recovery of hydrocarbons from the formation surfaces which have been blocked or sealed by the filter cake. Furthermore, when injectors are used to retain reservoir pressures, the injection of sea water, for instance, can be significantly reduced

due to the filter cake preventing the sea water from entering the formation and hence restricting the flow of water into the reservoir. Accordingly, the industry prefers to remove the filter cake from the well bore in order to optimize productivity. If the filter cake is not removed, the filter cake can block the pores that are part of the formation surface of the well bore which will interfere with the recovery of hydrocarbons. In many drilling operations, the drilling fluid can contain up to 5% by weight of a pore bridging material such as calcium carbonate. Calcium carbonate (CaCO3) is typically a blend of particle sizes with a particle size distribution designed to optimize the bridging of the pores found in the formation. The pore size distribution of the formation is determined from its permeability, preferably by direct porosity and permeability measurements of core plugs extracted from the reservoir.

Once drilling operations have been completed, the well is prepared for the completion operations whereby the mud used for drilling is often displaced by a completion fluid. Completion fluids are typically water based clear fluids and are formulated to the same density as the mud used to drill the well in order to retain the hydraulic pressure on the well bore. There are numerous methods of completing a well, amongst which are open hole completions and gravel packed screened systems. The clear fluids are typically halide based brines such as calcium bromide, calcium chloride, and zinc bromide; or organic based brines such as the formate based fluids.

In drilling an oil or gas well, the use of hydrocarbon-based drilling fluids are greatly preferred because of the inherent advantages of having an external phase fluid in contact with the formation. However, one severe disadvantage to a hydrocarbon-based drilling fluid is that weighting materials, such as barite, calcium carbonate, or hematite must be added to increase the density of the fluid. These weighting-material solids are capable of inducing formation damage to producing formations.

Thus, there is a need to provide hydrocarbon-based drilling fluids that are preferably solids free or have low solids in the contents in the drilling fluid in order to avoid the above-mentioned disadvantages.

SUMMARY OF THE PRESENT INVENTION

A feature of the present invention is to provide drilling fluids which are solids free or contain low amounts of solids in the drilling fluids.

Another feature of the present invention is to provide drilling fluids which are a hydrocarbon-water emulsion which are suitable for use as drilling fluids.

A further feature of the present invention is to provide drilling fluids which can have a variety of different densities in order to be useful in a variety of drilling situations depending on drilling depth and/or other variables.

Another feature of the present invention is to provide a more environmentally friendly drilling fluid that can be primarily aqueous based.

Additional features and advantages of the present invention will be set forth in part in the description that follows, and in part will be apparent from the description, or may be learned by practice of the present invention. The objectives and other advantages of the present invention will be realized and attained by means of the elements and combinations particularly pointed out in the description and appended claims.

To achieve these and other advantages, and in accordance with the purposes of the present invention, as embodied and broadly described herein, the present invention relates to a drilling fluid which contains at least one alkali metal formate and preferably at least one surfactant. Additional alkali metal formates, wetting agents, hydrocarbons, solid weighting materials, sealing or fluid loss agents, filtration control agents, and/or polymers to further control viscosity and/or other conventional additives such as organoclays and the like can also be optionally present for purposes of the present invention.

The present invention further relates to a method to drill a well comprising drilling of a well in the presence of the above-mentioned drilling fluid of the present invention.

The present invention further relates to a method to minimize or eliminate solids in a drilling fluid by substituting at least a portion of the solids weighting material with at least one alkali metal formate and preferably at least one surfactant.

It is to be understood that both the foregoing general description and the following

detailed description are exemplary and explanatory only and are intended to provide a further explanation of the present invention, as claimed.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

The present invention relates to drilling fluids for use in drilling operations. For instance, the drilling fluid can be used in the drilling of a well for hydrocarbon recovery such as oil and/or gas. The drilling fluids of the present invention can also be used in other drilling operations where drilling fluids are used.

The drilling fluid of the present invention contains at least one alkali metal formate or monovalent carboxylic acid salt and preferably at least one surfactant or emulsifier. The drilling fluid of the present invention can contain an emulsion of an aqueous-based solution with a hydrocarbon-based fluid for purposes of forming the drilling fluid wherein the drilling fluid contains at least one alkali metal formate and preferably at least one surfactant along with at least one hydrocarbon-based fluid.

Preferably, the drilling fluid contains cesium formate as the alkali metal formate. More preferably, the drilling fluid contains two or more alkali metal formates, wherein preferably one of the alkali metal formates is cesium formate. A preferred combination of formates includes, but is not limited to, cesium formate with potassium formate. Other combinations of alkali metal formates can be used, such as sodium formate and potassium formate or sodium formate and cesium formate. Essentially, any combination of one or more monovalent carboxylic salts can be used for purposes of the drilling fluids of the present invention.

The alkali metal formates are commercially available. For instance, the cesium formate can be obtained from Cabot Corporation. The cesium formate can be made, for instance, by following the description as set forth in International Published Patent Application No. WO 96/31435, incorporated in its entirety by reference herein. The cesium formate that is present in the drilling fluid, preferably as a soluble salt, as stated above, can be present in any concentration and the cesium formate solution is a liquid at room temperature. Therefore, the concentration of the cesium formate in the drilling fluid can be from about 1% to about 100% by weight, and

more preferably is present in an amount of from about 40% to about 95% by weight, and even more preferably is present in the drilling fluid at a range of from about 55% to about 85% by weight or is present in the drilling fluid at a range of from about 70% to about 85% by weight based on the weight of the drilling fluid. Besides the optional ingredients and preferably the surfactant and/or hydrocarbon fluid, the remainder of the drilling fluid can be water or other aqueous solutions. Conventional ingredients used in drilling fluids can also be used with the drilling fluid of the present invention.

Other alkali metal formates that can be used in the present invention are potassium formate and sodium formate which are commercially available. These alkali metal formates can also be prepared in a similar fashion as the cesium formate solution described above, and are also frequently obtained as by-products from ester hydrolysis.

Preferably, with respect to the drilling fluid of the present invention, at least 35 % by volume of the fluid in the drilling fluid is an aqueous-based solution containing at least one alkali metal formate. More preferably, at least 50% by volume of the fluids present in the drilling fluid is an aqueous-based solution containing at least one alkali metal formate and even more preferably at least 75 % by volume of the fluids present in the drilling fluid of the present invention is an aqueous-based solution containing at least one alkali metal formate. Most preferably, at least 90 % by volume of the fluids present in the drilling fluid of the present invention is an aqueous-based solution containing at least one alkali metal formate. In another embodiment, at least 95 % or more by volume of the fluids of the present invention contain an aqueous-based solution containing at least one alkali metal formate. In one embodiment, all of the fluids present are an aqueous-based solution containing at least one alkali metal formate wherein essentially no hydrocarbon, or oil is present in the drilling fluid. Since the alkali formate is preferably dissolved in the aqueous solution, the drilling fluid can be solids free since the alkali formate preferably acts as a lubricant and a weighting material.

When a hydrocarbon fluid or synthetic mud fluid is present in the drilling fluids of the present invention, conventional hydrocarbon fluids or synthetic mud fluids can be used in the drilling fluids of the present invention. Examples include, but are not limited to, diesel oil such as diesel oil number 2, crude oil, synthetic oils (such as paraffin oils, olefin oils, vegetable oils,

and the like), as well as other conventional hydrocarbon fluids. Combinations of various hydrocarbon fluids or synthetic mud fluids can be used for purposes of the present invention. If a hydrocarbon or synthetic mud fluid is present in the drilling fluid of the present invention, various ratios of the hydrocarbon fluid to the aqueous-based solution described above can be used, such as ratios of 65 % by volume hydrocarbon fluid: 35 % aqueous based solution to 1 % by volume hydrocarbon fluid: 99 % by volume aqueous based solution.

When a hydrocarbon fluid is present with the aqueous-based solution containing at least one alkali metal formate, at least one emulsifier or surfactant is preferably present in order to produce an emulsion of the ingredients. Essentially any emulsifier(s) or surfactant(s) capable of forming an emulsion between the hydrocarbon fluid and the aqueous based solution can be used for purposes of the present invention. Examples include, but are not limited to, a dimer trimer acid such as Witco DTA 350, imadazoline, tall oil (stearic acid), Integrity Synvert IV, Integrity Synvert TWA, and the like. Any amount of surfactant or emulsifier can be used to form the emulsion such as from about 1 to about 30 pounds per barrel, wherein a barrel is about 42 gallons.

Other optional ingredients that can be present in the drilling fluids of the present invention include a filtration control agent or pore bridging materials such as Gilsonite and the like. These filtration control agents can be used in conventional amounts.

Other ingredients that can be present in the drilling fluids of the present invention include solid weighting materials such as barite, hematite, and/or calcium carbonate. These solid weighting materials can be used if desired. The amount of solid weighting material, which is optional, can be from about 0.5 pound per barrel to about 500 pounds per barrel.

Another optional ingredient in the drilling fluids of the present invention is a wetting agent which can be helpful in emulsifying the alkali metal formate fluids with the hydrocarbon-based external fluids. An example of a suitable wetting agent is Integrity Synvert TWA. Conventional amounts can be used in combination with the emulsifiers described above in order to achieve desired emulsions of the formate fluids with the hydrocarbon-base external fluids.

Other ingredients that can optionally be present include, but are not limited to, other drilling fluid products such as polymer(s) to add to viscosity, hydrophilic clays, organophilic

clays, fluid loss control additives, amine-treated clays, clays treated such that they provide viscosity in non-aqueous fluids, and the like. These other optional ingredients can be used in conventional amounts known to those skilled in the art.

The alkali metal formate that is present as part of the aqueous-based solution can be not fully saturated in the aqueous-based solution so as to permit any remaining water-soluble components to preferably solubilize in the solution along with the alkali metal formate. Thus, the alkali metal formate that is present in the aqueous-based solution can be present in an amount of less than 80 % by weight, based on the aqueous-based solution basis, and more preferably is from about 60 % to about 80 % by weight.

The important advantage of the present invention is the ability for the density of the drilling fluid to be adjusted to any desired density. This can especially be done with the introduction of a combination of alkali metal formates, such as potassium formate with cesium formate. As an example, an aqueous-based portion of the drilling fluid can contain cesium formate which can range from about 1.8 to about 2.4 s.g. This density range can be adjusted with the introduction of potassium formate. For instance, when 0 to 100% by weight of potassium formate is included in the aqueous-based portion of the drilling fluid, the density of the overall aqueous-based portion of the drilling fluid can range from about 1.2 to about 2.4. Thus, the density of the drilling fluid can essentially be "dialed-in" to meet the density needed for the drilling fluid to be used in the drilling of the well bore at the appropriate depths. For lower density ranges, sodium formate can be added to the potassium formate, hence, "dialing-in" lower density drilling fluids.

Thus, the drilling fluids of the present invention make it possible to achieve a variety of different densities and to minimize or completely eliminate the solid weighting material that is present in conventional drilling fluids.

The drilling fluids of the present invention can be introduced into the well bore by any conventional technique such as, but not limited to, being pumped into the drill pipe. Further, the drilling fluids can be recovered using conventional techniques.

The drilling fluids of the present invention can be prepared by mixing all of the components together. When an emulsion is prepared, typically, the components will be mixed

together such as by shearing in order to ensure a dispersion that is preferably uniform with respect to the components.

For example, a typical parafinic hydrocarbon oil such as ESCAID 110, having a density of 0.803 s.g. (6.7 ppg) and a cesium formate solution having a density of 2.2 s.g. (18.36 ppg) when combined in a ratio of 1:1 and by addition of an emulsifier or a series of emulsifiers admixed by shearing, the fluids together can produce an emulsion or microemulsion that has a cesium formate invert phase or (internal phase) and an oil external phase. The density of the combined mixture of this example is 1.51 s.g. (12.6 ppg).

For purposes of the present invention, when a hydrocarbon-based external fluid is used with at least one formate fluid as described above, the formate fluids can be partially or totally emulsified into the hydrocarbon-based fluid. Or, in the alternative, when a majority of the drilling fluid is a formate fluid, the hydrocarbon-based fluid, if present, can be partially or totally emulsified into the formate fluid.

Optionally, the drilling fluids of the present invention can also contain at least one acid. Preferably, the acid is an acid containing at least one carboxylic group and more preferably is formic acid or an acid derivative thereof. Other examples of acids that can be used include, but are not limited to, acetic acid, ascorbic acid, citric acid, tartaric acid, phthalic acid, glycolic acid, and combinations thereof. The acid can be present in various amounts such as from about 1 % or less to 25 weight % or more based on the weight of the drilling fluid. The presence of the acid has the capability of adjusting the pH of the drilling fluid as well as providing other benefits to the drilling fluid. When an acid is present, for instance, the alkali metal formate fluid, such as cesium formate, can be present in any molar amount, but is preferably present in an amount of about 3 M. Similarly, the acid, when present, can be present in any molar amount, and is preferably present in an amount of from about 2.2 M to about 15 M. The pH of the drilling fluid can be any pH.

The present invention will be further clarified by the following examples, which are intended to be purely exemplary of the present invention.

EXAMPLES

Various drilling fluid formulations were prepared and tested to determine the ability of the drilling fluids to serve as suitable fluids for drilling.

In the Examples, cesium formate was used and as can be seen in the results summarized in the various tables, a drilling fluid was made that had low or zero solids content and had the capability to "dial-in" various densities using a combination of components described herein.

In the examples, a barrel is generally 42 gallons of liquid. IA-35 is a synthetic oil from Integrity Industries. Integrity Synvis is a viscosifier. Witco DTA 350 is a wetting agent. Baroid Baracarb 50 is calcium carbonate. Initial ES (volts) is electrical stability at the temperature shown below the values. Initial properties refers to apparent viscosity using a Fann 35 viscometer. SA refers to static-aged ES testing and 250 refers to testing at 250°F for 16 hours. "Silv" refers to a Silverson mixer.

The tests in the Tables were conducted in accordance with Recommended Practice Standard Procedure for Field Testing oil-based drilling fluids, API, 13B-2 (2nd Ed., Dec. 1, 1991), and Recommended Practice Standard Procedure API Recommended Procedure 13-I (5th Ed., June 1, 1995), incorporated in their entirety by reference herein.

Cesium formate, IA - 35 (50/50 mixture, 2.3 s.g. CsF) — **2.3 sg csf**

Mixing Procedure:

1. Measure out IA - 35
1A. Add Synvis, mix 5 minutes
2. Add CsF, mix 10 min.
3. Add Emulsifier Synvert, mix 10 minutes
3A. Add calcium carbonate, mix 10 minutes
4. Run initial ES, viscosities at 120°F
5. Put 10 ml sample in a vial, SA for 24 hrs at 75°F, measure volumes
6. Hot-roll for 16 hours at 150°F
7. Remix, run rheology, ES, API, HTHP at 150°F
8. Put vials in oven and static-age at 150°F for 24 hrs, measure volumes
9. If 150°F HTHP is good, run at 250°F

41.6/58.4 oil/csf ratio

Sample #	**337**		**338**		**339**	
IA - 35, grams	98.26		98.26		93.26	
Cesium Formate, grams	445 (2.366)		445 (2.366)		445 (2.366)	
Integrity Emulsifier, lb/bbl	25		25		20	
Integrity Synvis, lb/bbl	0.5		1		0.5	
Witco DTA 350, lb/bbl	-		-		-	
Baroid Baracarb 50, lb/bbl	50		50		50	
Initial ES, volts	103	129	167	166	114	151
Hot-rolled 16 hrs, ES	114	102	148	140	139	138
Initial Properties	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm	162	116	186	118	164	115
300 rpm	93	65	114	67	96	66
200 rpm	67	47	83	49	70	48
100 rpm	40	27	49	29	41	28
6 rpm	8	7	9	6	7	6
3 rpm	6	5	7	5	5	5
Plastic Viscosity, cP	69	51	72	51	68	49
Yield Pt, lb/100ft^2	24	14	42	16	28	17
Gels, 10 sec/10 min.	6/7	6/6	6/7	5/6	5/6	5/5
Settling in thermocup	no	no	no	no	no	no
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm	161	113	187	123	162	114
300 rpm	93	64	116	70	97	66
200 rpm	68	46	86	52	72	48
100 rpm	39	27	52	30	473	28
6 rpm	8	6	10	6	7	6
3 rpm	6	5	8	5	5	4

Sample #	337		338		339	
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
Plastic Viscosity, cP	68	49	71	53	65	48
Yield Pt, lb/100ft^2	25	15	45	17	32	18
Gels, 10 sec/10 min.	6/6	5/6	7/9	5/6	6/6	5/5
API filt, ml total	1.0		0.2		0.4	
API filt, ml oil	-		-		-	
API filt, ml emulsion	1.0		0.2		0.4	
API filt, ml brine	-		-		-	
HTHP at 150°F, ml					0.2	
HTHP at 250°F, ml					11.4	
250°F oil					0.0	
250°F emulsion					6.8	
250°F brine					4.6	

Comments

NOTE: 1. Sample 337 and 338 looked grainy with 15 lb/bbl Synvert V. Concentration was increased to 25 lb/bbl.
After hot-rolling at 150°F, #337 and #338 still appear grainy.
2. Mud weight of 339 is 14.7 lb/gal (CsF in 337-339 is 2.366 s.g)

41.6/58.4 oil/csf ratio

Sample #	340		347		348	
IA - 35, grams	93.26		88.26		88.26	
Cesium Formate, grams	445 (2.366)		445 (2.3)		445 (2.3)	
Integrity Emulsifier, lb/bbl	20		25		25	
Integrity Synvis, lb/bbl	1		-		-	
Witco DTA 350, lb/bbl	-		0.5		1	
Baroid Baracarb 50, lb/bbl	50		50		50	
Initial ES, volts	117	128	212	192	205	243
Hot-rolled 16 hrs, ES	122	118	148	145	252	247
Initial Properties	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm	183	126	177	132	182	132
300 rpm	109	73	106	78	111	80
200 rpm	80	53	77	57	83	61
100 rpm	47	31	46	347	52	38
6 rpm	8	6	8	7	10	8
3 rpm	6	5	6	5	7	6
Plastic Viscosity, cP	74	53	71	54	71	52
Yield Pt, lb/100ft^2	35	20	35	24	40	28
Gels, 10 sec/10 min.	6/7	5/5	6/6	6/6	8/8	6/7
Settling in thermocup	no	no	no	no	no	no
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm	184	129	179	140	184	144
300 rpm	111	75	109	84	113	88
200 rpm	82	55	80	62	85	66
100 rpm	49	32	48	37	52	41
6 rpm	8	6	8	7	10	9
3 rpm	6	5	6	5	8	7

Sample #	340		347		348	
HR 16 hrs at 150°F	120°F	150°F	120°F	150°F	120°F	150°F
Plastic Viscosity, cP	73	56	70	56	71	56
Yield Pt, lb/100ft^2	38	28	39	32	42	32
Gels, 10 sec/10 min.	6/7	5/6	6/6	5/5	8/8	7/9
API filt, ml total	0.3		3.5		6.2	
API filt, ml oil	-		-		-	
API filt, ml emulsion	0.3		3.5		6.2	
API filt, ml brine	-		-		-	
HTHP at 150°F, ml	0.2		19.4	(0.8 brine)		
HTHP at 250°F, ml	4.4					
250°F oil	0.0					
250°F emulsion	3.2					
250°F brine	1.2					
Comments						

NOTE: **1. Mud weight of 339 is 14.7 lb/gal (CsF in 340 is 2.366 s.g)**
2. Mud weight of 347 is 14.6 lb/gal (CsF in 347-348 is 2.30 s.g)

41.6/58.4 oil/csf ratio

Sample #	341	342	343	344	345	346
IA - 35, grams	88.26	88.26	98.26	98.26	93.26	93.26
Cesium Formate, grams	445	445	445	445	445	445
Integrity Emulsifier, lb/bbl	25	25	15	15	20	20
Integrity Synvis, lb/bbl	0.5	1	-	-	-	-
Witco DTA 350, lb/bbl	-	-	0.5	1	0.5	1
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50

Cesium Formate, Escaid 110 (50/50 mixture)

Mixing Procedure:
1. Measure out Escaid 110, add Organoclay, mix 10 minutes
2. Add emulsifier(s), mix 5 minutes, add Gilsonite, mix 10 minutes
3. Add CsF, mix 10 min on HB, add CaCO3, mix 10 min on HB
4. Run initial ES, viscosities at 120 F
5. Put 10 ml sample in vial, SA for 24 hrs at 75 F, measure volume
6. Hot Roll for 16 hrs. at 150 F
7. Remix, run rheology es, HPHT @ 250 F
8. Put vial in oven SA 24 hrs @ 150 F

Sample #	E-1	E-2	E-3	E-4
Integrity Synvert IV, lb/bbl	10	15	10	10
Dimer-Trimer acid, lb/bbl	0	0	0	1
Integrity Synvert TWA, lb/bbl	0	0	0	6
Organoclay, lb/bbl	0	0	4	4
Gilsonite, lb/bbl	0	0	5	5
CaCo3, lb/bbl	0	0	50	50
ES @ 120 F	225	289	170	175
Hot-rolled 16 hrs, ES @ 120 F	395	440	365	350
Initial Properties				
600 rpm @ 120 F	28	30	85	92
300 rpm @ 120 F	15	16	40	50
200 rpm @ 120 F	10	11	31	41
100 rpm @ 120 F	5	6	15	25
6 rpm @ 120 F	0	1	3	6
3 rpm @ 120 F	0	0	1	5
Plastic Viscosity, cP	13	14	45	42
Yield Point, lb/100 ftsq	2	2	5	8
Gels, 10 sec/10 min	0/0	0/1	1/4	5/8
HR 16 hrs @ 150 F				
600 rpm @ 120 F	31	33	96	110
300 rpm @ 120 F	16	18	49	62
200 rpm @ 120 F	10	12	35	53
100 rpm @ 120 F	5	6	20	40
6 rpm @ 120 F	0	2	4	10
3 rpm @ 120 F	0	1	2	6
Plastic Viscosity, cP	15	15	47	48
Yield Point, lb/100 ftsq	1	3	4	14
Gels, 10 sec/ 10 min.	0/0	1/1	3/4	7/9
HPHT @ 250 F, ml	30	26	8	6
Water in filtrate, ml	4	3	0	0
24 hrs @ 75 F				
Free Oil %	10	8	5	3
Emulsion %	90	92	95	97
Free Brine %	0	0	0	0

Cesium Formate, IA-35 (75/25 mixture)

Mixing Procedure:
1. Measure out IA-35, add Organoclay, mix 10 minutes
2. Add emulsifier(s), mix 5 minutes, add Gilsonite, mix 10 minutes
3. Add CsF, mix 10 min on HB, add CaCO3, mix 10 min on HB
4. Run initial ES, viscosities at 120 F
5. Put 10 ml sample in vial, SA for 24 hrs at 75 F, measure volume
6. Hot Roll for 16 hrs. at 250 F
7. Remix, run rheology es, HPHT @ 150 F
8. Put vials in oven SA 24 hrs @ 150 F

Sample #	1	2	3	4	5
Integrity Synvert IV, lb/bbl	10	15	10	10	15
Dimer-Trimer acid, lb/bbl	0	0	0	1	1
Integrity Synvert TWA, lb/bbl	0	0	0	6	6
Organoclay, lb/bbl	0	0	4	4	4
Gilsonite, lb/bbl	0	0	5	5	5
CaCo3, lb/bbl	0	0	50	50	50
ES @ 120 F	226	250	270	175	225
Hot-rolled 16 hrs, ES @ 120 F	185	200			
Initial Properties					
600 rpm @ 120 F	251	265	t	t	t
300 rpm @ 120 F	169	172	o	o	o
200 rpm @ 120 F	135	133	o	o	o
100 rpm @ 120 F	92	184			
6 rpm @ 120 F	26	13	t	t	t
3 rpm @ 120 F	20	8	h	h	h
			i	i	i
Plastic Viscosity, cP	82	93	c	c	c
Yield Point, lb/100 ftsq	87	79	k	k	k
Gels, 10 sec/10 min	24/28	8/12			
HR 16 hrs @ 150 F					
600 rpm @ 120 F	276	259			
300 rpm @ 120 F	175	166			
200 rpm @ 120 F	140	101			
100 rpm @ 120 F	99	22			
6 rpm @ 120 F	29	14			
3 rpm @ 120 F	22	8			
Plastic Viscosity, cP	101	93			
Yield Point, lb/100 ftsq	74	73			
Gels, 10 sec/ 10 min.	22/23	8/12			
HPHT @ 250 F, ml	23	16			
Water in filtrate, ml	8	4			
24 hrs @ 75 F					
Free Oil %	1	0	0		
Emulsion %	99	100	100		
Free Brine %	0	0	0		
24 hrs @ 150 F					
Free oil %	2	2	0		
Emulsion %	98	98	100		
Free Brine %	0	0	0		

Observational Notes:

- Emulsion is clear at temperatures above 130 F
- Amount of shear imparted to system is directly related to emulsion stability
- Heating the emulsion to 150 F acts to stabilize emulsion (similar to shearing)
- Oil/Water ratios as low as 25/75 are achievable with this system

Cesium Formate, IA-35 (50/50 mixture)

Mixing Procedure:
1. Measure out IA-35, add Organoclay, mix 10 minutes
2. Add emulsifier(s), mix 5 minutes, add Gilsonite, mix 10 minutes
3. Add CsF, mix 10 min on HB, add CaCO3, mix 10 min on HB
4. Run initial ES, viscosities at 120 F
5. Put 10 ml sample in vial, SA for 24 hrs at 75 F, measure volume
6. Hot Roll for 16 hrs. at 150 F
7. Remix, run rheology es, HPHT @ 250 F
8. Put vials in oven SA 24 hrs @ 150 F

Sample #	1	2	3	4	5
Integrity Synvert IV, lb/bbl	10	15	10	10	15
Dimer-Trimer acid, lb/bbl	0	0	0	1	1
Integrity Synvert TWA, lb/bbl	0	0	0	6	6
Organoclay, lb/bbl	0	0	4	4	4
Gilsonite, lb/bbl	0	0	5	5	5
CaCo3, lb/bbl	0	0	50	50	50
ES @ 120 F	226	255	241	150	231
Hot-rolled 16 hrs, ES @ 120 F	425	475	427	320	444
Initial Properties					
600 rpm @ 120 F	39	42	162	181	155
300 rpm @ 120 F	20	22	93	131	92
200 rpm @ 120 F	14	15	66	110	67
100 rpm @ 120 F	7	8	36	81	39
6 rpm @ 120 F	0	1	3	33	6
3 rpm @ 120 F	0	0	2	28	4
Plastic Viscosity, cP	19	20	69	50	63
Yield Point, lb/100 ftsq	1	2	24	81	29
Gels, 10 sec/10 min	0/0	0/2	3/7	29/32	7/7
HR 16 hrs @ 150 F					
600 rpm @ 120 F	51	55	169	195	188
300 rpm @ 120 F	27	29	101	145	114
200 rpm @ 120 F	14	14	75	113	86
100 rpm @ 120 F	9	10	43	87	51
6 rpm @ 120 F	1	1	4	37	8
3 rpm @ 120 F	0	1	2	30	5
Plastic Viscosity, cP	24	26	68	50	74
Yield Point, lb/100 ftsq	3	3	33	95	40
Gels, 10 sec/ 10 min.	0/0	0/1	3/3	33/35	5/6
HPHT @ 250 F, ml	28	22	15	14	6
Water in filtrate, ml	4	3	2	2	0
24 hrs @ 75 F					
Free Oil %	5	10	4	3	2
Emulsion %	95	90	96	97	98
Free Brine %	0	0	0	0	0
24 hrs @ 150 F					
Free oil %	18	15	10	0	
Emulsion %	92	85	90	94	
Free Brine %	0	0	0	0	

Cesium formate, Escaid 110 (50/50 mixture)	175 ml Escaid 110 (0.803 sg) - (140.5 grams) 175 ml Cesium Formate (2.2 sg) - (385 grams)

Mixing Procedure:

1. Measure out Escaid 110, add Geltone II, mix 10 minutes
2. Add emulsifiers (Below in bold), mix 5 minutes, add Barablock, mix 10 minutes
3. Add CsF, mix 10 min. on HB, add Lo-Wate, mix 10 min. on HB
4. Run initial ES, viscosities at 120°F
5. Put 10 ml sample in a vial, SA for 24 hrs at 75°F, measure volumes
6. Hot-roll for 16 hours at 150°F
7. Remix, run rheology, ES, API, HTHP at 150°F
8. Put vials in oven and static-age at 150°F for 24 hrs, measure volumes
9. If 150°F HTHP is good, run at 250°F

5

Sample #	225	226	227	228	229	230
Integrity Synvert II (Lot# 991512), lb/bbl	7	7	7	7	7	7
Witco DTA 350 (dimer-trimer), lb/bbl	1	1	1	1	1	1
Integrity Synvert TWA (1/24/00, D116), lb/bbl	2	4	6	2	4	6
Baroid Geltone II, lb/bbl	-	-	-	4	4	4
Baroid Barablock 400, lb/bbl	-	-	-	-	-	-
M-I Lo-Wate, lb/bbl	50	50	50	50	50	50
Initial ES, volts	107	194	247	127	123	128
Hot-rolled 16 hrs, ES	426	450	290	150	185	170
Initial Properties						
600 rpm at 75°F	80	67	80	99	74	87
300 rpm	58	48	60	75	52	60
200 rpm	49	40	51	64	43	48
100 rpm	37	31	39	49	31	35
6 rpm	13	10	13	18	12	13
3 rpm	10	5	4	15	10	11
Plastic Viscosity, cP	22	19	20	24	22	27
Yield Pt, lb/100ft^2	36	29	40	51	30	33
Gels, 10 sec/10 min.	11/7	5/7	7/3	15/15	10/10	10/11
HR 16 hrs at 150°F						
600 rpm at 120°F	71	89	95	94	75	70
300 rpm	53	69	74	68	52	48
200 rpm	44	59	63	56	43	39
100 rpm	34	45	49	42	31	28
6 rpm	10	12	12	17	12	10

3 rpm	4	5	4	13	10	8
Sample #	**225**	**226**	**227**	**228**	**229**	**230**
Plastic Viscosity, cP	18	20	21	26	23	22
Yield Pt, lb/100ft^2	35	49	53	42	29	26
Gels, 10 sec/10 min.	7/4	9/4	10/4	12/13	10/11	9/9
API filtrate, ml	0.8	1.1	1.1	1.6	0.9	0.6
API Filtrate, oil	0	0	0	0	0	0
API Filtrate, brine	0	0	0	0	0	0
HTHP at 150°F, ml	8.8	3.0	5.0	3.5	1.6	0.8
Water in filtrate?	6.0	2.5	2.5	1.5	0.4	0.0
HTHP at 250°F, ml	24.0	18.0	12.0	8.2	4.2	2.5
Water in filtrate?	12.0	9.0	3.1	2.6	1.7	0.6
24 hrs at 75°F						
Total fluid heighth	34	35	34	35	36	33
free oil heighth	6	3	2	1	1	2
emusion heighth	28	32	32	34	35	31
free brine heighth	0	0	0	0	0	0
free oil, %	18%	9%	6%	3%	3%	6%
emusion, %	82%	91%	94%	97%	97%	94%
free brine, %	0%	0%	0%	0%	0%	0%
24 hrs at 150°F						
Total fluid heighth	34	36	35	35	37	32
free oil heighth	8	8	6	3	3	4
emusion heighth	26	28	29	32	34	28
free brine heighth	0	0	0	0	0	0
free oil, %	24%	22%	17%	9%	8%	13%
emusion, %	76%	78%	83%	91%	92%	88%
free brine, %	0%	0%	0%	0%	0%	0%
Difference (72 hrs/24 hrs at 150°F)						
free oil, %	6%	14%	11%	6%	5%	6%
emusion, %	-6%	-14%	-11%	-6%	-5%	-6%
free brine, %	0%	0%	0%	0%	0%	0%
Sample #	**231**	**232**	**233**	**234**	**235**	**236**
Integrity Synvert II (Lot# 991512), lb/bbl	7	7	7	7	7	7
Witco DTA 350 (dimer-trimer), lb/bbl	1	1	1	1	1	1
Integrity Synvert TWA (1/24/00, D116), lb/bbl	2	4	6	2	4	6
Baroid Geltone II, lb/bbl	-	-	-	4	4	4
Baroid Barablock 400, lb/bbl	5	5	5	5	5	5
M-I Lo-Wate, lb/bbl	50	50	50	50	50	50
Initial ES, volts	139	263	249	105	133	161
Hot-rolled 16 hrs, ES	402	314	307	144	196	245
Initial Properties						
600 rpm at 75°F	81	90	85	86	81	84
300 rpm	63	69	65	62	57	60
200 rpm	52	59	55	50	47	49
100 rpm	40	46	43	37	34	37

6 rpm	17	14	14	12	14	14
3 rpm	12	5	5	10	12	12
Sample #	**231**	**232**	**233**	**234**	**235**	**236**
Plastic Viscosity, cP	18	21	20	24	24	24
Yield Pt, lb/100ft^2	45	48	45	38	33	36
Gels, 10 sec/10 min.	17/15	10/5	11/6	10/11	12/13	12/12
HR 16 hrs at 150°F						
600 rpm at 120°F	111	118	122	63	90	110
300 rpm	84	92	96	43	62	76
200 rpm	71	78	83	35	50	62
100 rpm	53	61	65	25	37	45
6 rpm	17	18	21	9	13	16
3 rpm	7	7	7	7	11	14
Plastic Viscosity, cP	27	26	26	20	28	34
Yield Pt, lb/100ft^2	57	66	70	23	34	42
Gels, 10 sec/10 min.	13/5	12/6	13/5	7/8	10/11	13/14
API filtrate, ml	1.2	1.2	0.3	0.2	0.2	0.0
API Filtrate, oil	0	0	0	0	0	0
API Filtrate, brine	0	0	0	0	0	0
HTHP at 150°F, ml	2.6	2.0	1.4	2.0	trace	trace
Water in filtrate?	0.0	0.0	0.0	0.0	0.0	0.0
HTHP at 250°F, ml	9.0	8.0	6.0	7.0	5.0	4.0
Water in filtrate?	0.0	0.0	0.0	0.0	0.0	0.0
24 hrs at 75°F						
Total fluid heighth	35	35	35	34	34	34
free oil heighth	3	2	3	2	1	1
emusion heighth	32	33	32	32	33	33
free brine heighth	0	0	0	0	0	0
free oil, %	9%	6%	9%	6%	3%	3%
emusion, %	91%	94%	91%	94%	97%	97%
free brine, %	0%	0%	0%	0%	0%	0%
24 hrs at 150°F						
Total fluid heighth	35	36	35	34	35	35
free oil heighth	7	6	6	6	4	3
emusion heighth	28	30	29	28	31	32
free brine heighth	0	0	0	0	0	0
free oil, %	20%	17%	17%	18%	11%	9%
emusion, %	80%	83%	83%	82%	89%	91%
free brine, %	0%	0%	0%	0%	0%	0%
Difference (72 hrs/24 hrs at 150°F)						
free oil, %	11%	11%	9%	12%	8%	6%
emusion, %	-11%	-11%	-9%	-12%	-8%	-6%
free brine, %	0%	0%	0%	0%	0%	0%

Mixing Order:
1. Measure out IA 35 base oil
2. Add Synvert IV
3. Add cesium formate
4. Mix on HB, Silverson to 135°F

Sample #	1	2	3	4	5
IA-35, %	90	75	50	25	10
Synvert IV, lb/bbl	20	20	20	20	20
2.2 s.g. Cs Formate, %	10	25	50	75	90
Initial Rheologies					
Mud weight, lb/gal	7.81	9.4	11.94	14.47	17.18
600 rpm at 120°F	7	13	42	>300	too
300 rpm	4	7	21	274	thick
200 rpm	3	5	14	218	to
100 rpm	2	3	7	149	measure
6 rpm	0.2	0.5	1	38	
3 rpm	0.2	0.5	0.5	28	
PV	3	6	21	-	-
YP	1	1	0	-	-
Gels	.5/.5	1/1	1/1	28/32	-
ES	373	310	362	328	133
Vials 16 hrs at 75°F					
Total Heighth	32	32	32	31	
Oil	18	1	0	0	
Emulsion	14	31	32	31	
Formate					
Samples H.R. for 16 hours at 150°F					
600 rpm at 120°F	6	13	45	>300	too
300 rpm	3	7	23	273	thick
200 rpm	2	4	16	222	to
100 rpm	1	2	8	158	measure
6 rpm	0	0	2	49	
3 rpm	0	0	2	40	
PV	3	6	22	-	-
YP	0	1	1	-	-
Gels	1/1	0/0	2/2	38/42	-
ES	1069	211	232	271	115
Vials 7 hrs at 150°F					
Total Heighth	32	32	32	32	
Oil	22	3	1	0	
Emulsion	10	29	31	32	
Formate					

Sample #	1	2	3	4	5
Vials 64 hrs at 200°F					
Total Heighth	105	103	100	100	105
Oil	89	66	40	0	0
Emulsion	8	12	60	100	105
Formate	8	25	0	0	0
Vials 64 hrs at 250°F					
Total Heighth	103	100	100	100	110
Oil	95	70	30	32	0
Emulsion	8	7	65	60	110
Formate	0	23	5	8	0
Vials 64 hrs at 300°F					
Total Heighth	102	105	102	102	104
Oil	92	70	42	32*	19*
Emulsion	10	10	10		
Formate	0	25	50	70	85

* combination oil and emulsion

Integrity Synvert IV Sample
1 gallon can

Test Procedure

1. Mix sample
2. Place aliquots of sample in large test tubes
3. Static-age samples for 24 hours at 200, 250, and 300Ff, 300 psi N2
4. Static-age samples for 72 hours at 200, 250, and 300F, 300 psi N2
5. Measure total heighth, oil, emulsion, and brine

24 hour tests

	200°F	250°F	300°F
Total heighth, mm	100	99	99
Free Oil, mm	9	16	30
Emulsion, mm	84	73	46
Free Brine, mm	7	10	23
% Oil	9.0%	16.2%	30.3%
% Emulsion	84.0%	73.7%	46.5%
% Brine	7.0%	10.1%	23.2%

72 hour tests

	200°F	250°F	300°F
Total heighth, mm	96	101	97
Free Oil, mm	5	10	30
Emulsion, mm	81	71	22
Free Brine, mm	10	20	45
% Oil	5.2%	9.9%	30.9%
% Emulsion	84.4%	70.3%	22.7%
% Brine	10.4%	19.8%	46.4%

Note: the 24 hr 300°F, and the 72 hour 200 and 250°F fluids appeared to have two phases in the emulsion portion. One phase is more distinctly oil and the second phase is more distinctly emulsion.

Sample of 50/50 mix from Integrity (one gallon can)

600 rpm at 75°F	90
300 rpm	49
200 rpm	34
100 rpm	18
6 rpm	2
3 rpm	1
PV	41
YP	8
Gels	2/2
ES	457

Integrity Turpene-Formate Sample

Vials 3 and 7 days at 200°F	3 days	7 days
Total Heighth	50	52
Oil	20	15
Emulsion	0	0
Formate	30	37
Vials 3 and 7 days at 250°F		
Total Heighth	54	51
Oil	17	15
Emulsion	0	0
Formate	37	36
Vials 3 and7 days at 300°F		
Total Heighth	51	50
Oil	15	15
Emulsion	0	0
Formate	36	35

		SA 250 Initial	SA 250 Silv.		SA 250 Initial	SA 250 Silv.	
Sample #	**349**	**349.5**	**349.75**	**350**	**350.5**	**350.75**	**353**
IA - 35, grams	94.26	94.26	94.26	94.26	94.26	94.26	89.26
Cesium Formate, grams	445	445	445	445	445	445	445
Integrity Emulsifier, lb/bbl	20	20	20	20	20	20	25
Integrity Synvis, lb/bbl	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Witco DTA 350, lb/bbl	-	-	-	0.5	0.5	0.5	-
Baroid Barablock, lb/bbl	-	-	-	-	-	-	-
M-I Lo Wate, lb/bbl	50	50	50	50	50	50	50
Initial ES, volts	227			256			301
Hot-rolled 16 hrs, ES	109			209			339
Static-aged ES, volts		113			154		
Initial Properties	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**
600 rpm	188	147	-	179	148	-	203
300 rpm	113	90	-	108	88	-	122
200 rpm	83	68	-	80	65	-	90
100 rpm	49	41	-	48	39	-	53
6 rpm	8	6	-	6	6	-	7
3 rpm	5	4	-	4	4	-	5
Plastic Viscosity, cP	75	57	-	71	60	-	81
Yield Pt, lb/100ft^2	38	33	-	37	28	-	41
Gels, 10 sec/10 min.	5/6	5/6	-	4/5	4/6	-	6/6
Settling in thermocup	no	no	-	no	no	-	no
Initial ES, volts	253			266			295
Hot-rolled 16 hrs, ES	205	145	331	222	175	330	242

		SA 250 Initial	SA 250 Silv.		SA 250 Initial	SA 250 Silv.	
HR 16 hrs at 150°F	**150°F**	**150°F**	**150°F**	**150°F**	**150°F**	**150°F**	**150°F**
600 rpm	137	98	121	137	104	121	158
300 rpm	81	58	70	82	60	70	95
200 rpm	60	42	51	61	44	51	70
100 rpm	36	25	30	37	26	30	42
6 rpm	7	4	5	7	5	5	8
3 rpm	5	3	3	5	3	3	6

HR 16 hrs at 150°F	150°F	SA 250 Initial 150°F	SA 250 Silv. 150°F	150°F	SA 250 Initial 150°F	SA 250 Silv. 150°F	150°F
Plastic Viscosity, cP	56	40	51	55	44	51	63
Yield Pt, lb/100ft^2	25	18	19	27	16	19	32
Gels, 10 sec/10 min.	6/6	3/3	3/4	5/5	3/4	3/4	6/6
API filt, ml total	0.7	-	-	0.4	-	-	0.3
API filt, ml oil	0	-	-	0	-	-	0
API filt, ml emulsion	0.7	-	-	0.4	-	-	0.3
API filt, ml brine	0.0	-	-	0.0	-	-	0.0
HTHP at 250°F, ml	3.2	-	1.6	8.8	-	2.0	4.8
250°F oil	2.4	-	-	6	-	-	3.6
250°F emulsion	0.8	-	1.6	2.8	-	2.0	1.2
250°F brine	-	-	-	-	-	-	-
Free Oil, %			22%			25%	

Sample #	SA 250 Initial 353.5	SA 250 Silv. 353.75	354	SA 250 Initial 354.5	SA 250 Silv. 354.75
IA - 35, grams	89.26	89.26	89.26	89.26	89.26
Cesium Formate, grams	445	445	445	445	445
Integrity Emulsifier, lb/bbl	25	25	25	25	25
Integrity Synvis, lb/bbl	0.5	0.5	0.5	0.5	0.5
Witco DTA 350, lb/bbl	-	-	0.5	0.5	0.5
Baroid Barablock, lb/bbl	-	-	-	-	-
M-I Lo Wate, lb/bbl	50	50	50	50	50
Initial ES, volts			384		
Hot-rolled 16 hrs, ES			306		
Static-aged ES, volts	150			240	
Initial Properties	120°F	120°F	120°F	120°F	120°F
600 rpm	159	-	224	205	-
300 rpm	97	-	138	125	-
200 rpm	73	-	103	93	-
100 rpm	44	-	65	56	-
6 rpm	7	-	10	9	-
3 rpm	5	-	7	7	-
Plastic Viscosity, cP	62	-	86	80	-
Yield Pt, lb/100ft^2	35	-	52	45	-
Gels, 10 sec/10 min.	6/7	-	7/8		-
Settling in thermocup	no	-	no	no	-
Initial ES, volts			387		
Hot-rolled 16 hrs, ES	161	369	314	218	336

	SA 250 Initial	SA 250 Silv.		SA 250 Initial	SA 250 Silv.
HR 16 hrs at 150°F	**150°F**	**150°F**	**150°F**	**150°F**	**150°F**
600 rpm	114	136	167	133	157
300 rpm	68	80	102	78	94
200 rpm	50	59	76	57	69
100 rpm	30	35	47	34	41
6 rpm	5	7	10	6	6
3 rpm	4	5	8	4	4
Plastic Viscosity, cP	46	56	65	55	63
Yield Pt, lb/100ft^2	22	24	37	23	31
Gels, 10 sec/10 min.	4/5	5/6	8/8	5/5	5/5
API filt, ml total	-	-	1.8	-	-
API filt, ml oil	-	-	0.1	-	-
API filt, ml emulsion	-	-	1.7	-	-
API filt, ml brine	-	-	0.0	-	-
HTHP at 250°F, ml	-	2.4	3.6	-	4.8
250°F oil	-	-	0.4	-	0.3
250°F emulsion	-	1.0	3.2	-	2.5
250°F brine	-	1.4	-	-	2.0
Free Oil, %		25%			25%

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Sample #	351		355		359	
IA - 35, grams	94.26		89.26		84.26	
Cesium Formate, grams	445 (2.3)		445 (2.3)		445 (2.3)	
Integrity Emulsifier, lb/bbl	20		25		30	
Integrity Synvis, lb/bbl	0.5		0.5		0.5	
Witco DTA 350, lb/bbl	0.5		0.5		0.5	
Baroid Barablock, lb/bbl	10		10		10	
M-I Lo Wate, lb/bbl	50		50		50	
Initial ES, volts	301	300	357	365	440	492
Hot-rolled 16 hrs, ES	308	348	328	325	368	389
Initial Properties	120°F	150°F	120°F	150°F	120°F	150°F
600 rpm	195	193	241	227	300+	300+
300 rpm	117	120	147	143	253	233
200 rpm	87	91	111	110	196	182
100 rpm	53	56	70	70	127	119
6 rpm	7	10	12	15	28	29
3 rpm	5	7	8	11	20	22
Plastic Viscosity, cP	78	73	94	84	-	-
Yield Pt, lb/100ft^2	39	47	53	59	-	-
Gels, 10 sec/10 min.	5/6	8/9	8/10	11/14	19/22	22/26
Settling in thermocup	no	no	1	2	9	10
HR 16 hrs at 150°F	120°F	150°F	120°F	150°F	120°F	150°F
600 rpm	300+	226	300+	274	300+	300+
300 rpm	201	140	246	171	300+	242
200 rpm	154	106	188	129	282	186
100 rpm	98	67	119	81	181	121
6 rpm	20	15	25	19	42	32
3 rpm	15	11	19	15	32	26
Plastic Viscosity, cP	-	86	-	103	-	-
Yield Pt, lb/100ft^2	-	54	-	68	-	-
Gels, 10 sec/10 min.	14/19	11/12	18/22	14/15	32/33	25/27
API filt, ml total	0		0.0		0.0	
API filt, ml oil	-		0.0		0.0	
API filt, ml emulsion	0		0.0		0.0	
API filt, ml brine	-		0.0		0.0	
HTHP at 150°F, ml						
HTHP at 250°F, ml	trace		1.2		trace	
250°F oil			0.0		0.0	
250°F emulsion			1.2		trace	
250°F brine			0.0		0.0	

Cesium formate, IA - 35 (42/58 mixture, 2.3 s.g. CsF) **2.3 sg csf**

Mixing Procedure:

1. Measure out IA - 35
2. Add Synvis, mix 5 minutes
3. Add CsF, mix 10 min.
4. Add Synvert 5, mix 10 minutes
5. Add DTA 350, mix on Silverson to 120°F
6. Add calcium carbonate, mix 10 minutes on HB
7. Run initial ES, viscosities at 120°F
8. Put 10 ml sample in a vial, SA for 24 hrs at 75°F, measure
9. Hot-roll for 16 hours at 150°F
10. Remix, run rheology, ES, API, HTHP at 150°F
11. Put vials in oven and static-age at 150°F for 24 hrs, measure
12. If 150°F HTHP is good, run at 250°F

Sample #	**349**		**350**		**351**		**352**	
IA - 35, grams	94.26		94.26		94.26		94.26	
Cesium Formate, grams	445 (2.3)		445 (2.3)		445 (2.3)		445 (2.3)	
Integrity Emulsifier, lb/bbl	20		20		20		20	
Integrity Synvis, lb/bbl	0.5		0.5		0.5		0.5	
Witco DTA 350, lb/bbl	-		0.5		0.5		1.0	
Baroid Barablock, lb/bbl	-		-		10		-	
M-I Lo Wate, lb/bbl	50		50		50		50	
Initial ES, volts	227	253	256	266	301	300	283	365
Hot-rolled 16 hrs, ES	109	205	209	222	308	348	262	276
Initial Properties	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm	188	138	179	134	195	193	179	146
300 rpm	113	81	108	80	117	120	112	92
200 rpm	83	59	80	59	87	91	84	70
100 rpm	49	35	48	35	53	56	53	43
6 rpm	8	6	6	5	7	10	7	6
3 rpm	5	5	4	4	5	7	4	4
Plastic Viscosity, cP	75	57	71	54	78	73	67	54
Yield Pt, lb/100ft^2	38	24	37	26	39	47	45	38
Gels, 10 sec/10 min.	5/6	5/5	4/5	4/5	5/6	8/9	4/5	5/5
Settling in thermocup	no	no	no	no	no	no	no	no
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm	187	137	196	137	300+	226	189	143
300 rpm	114	81	120	82	201	140	119	90
200 rpm	85	60	90	61	154	106	91	69
100 rpm	52	36	56	37	98	67	60	44
6 rpm	9	7	9	7	20	15	12	9
3 rpm	7	5	7	5	15	11	8	6

Sample #	349		350		351		352	
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
Plastic Viscosity, cP	73	56	76	55	-	86	70	53
Yield Pt, lb/100ft^2	41	25	44	27	-	54	49	37
Gels, 10 sec/10 min.	7/7	6/6	6/8	5/5	14/19	11/12	8/10	6/7
API filt, ml total	0.7		0.4		0		1.2	
API filt, ml oil	-		-		-		0.1	
API filt, ml emulsion	0.7		0.4		0		1.1	
API filt, ml brine	-		-		-		-	
HTHP at 150°F, ml	-		-					
HTHP at 250°F, ml	3.2		8.8		trace		3.6	
250°F oil	2.4		6.0				2.8	
250°F emulsion	0.8		2.8				0.8	
250°F brine	0.0		0.0				0.0	
Comments								
24 hrs at 75°F								
Total fluid heighth	38		38		38		38	
free oil heighth	0		0		0		0	
emusion heighth	38		38		38		38	
free brine heighth	0		0		0		0	
free oil, %	0		0		0		0	
emusion, %	100%		100%		100%		100%	
free brine, %	0		0		0		0	
24 hrs at 150°F								
Total fluid heighth	38		38		38		38	
free oil heighth	0		0		0		0	
emusion heighth	38		38		38		38	
free brine heighth	0		0		0		0	
free oil, %	0		0		0		0	
emusion, %	100%		100%		100%		100%	
free brine, %	0		0		0		0	

Sample #	355	356	357	358
IA - 35, grams	89.26	89.26	84.26	84.26
Cesium Formate, grams	445 (2.3)	445 (2.3)	445 (2.3)	445 (2.3)
Integrity Emulsifier, lb/bbl	25	25	30	30
Integrity Synvis, lb/bbl	0.5	0.5	0.5	0.5
Witco DTA 350, lb/bbl	0.5	1.0	-	0.5
Baroid Barablock, lb/bbl	10	-	-	-
M-I Lo Wate, lb/bbl	50	50	50	50

Initial ES, volts	357	365	329	311	335	316	344	321
Hot-rolled 16 hrs, ES	328	325	307	307	298	301	301	272

Sample #	355		356		357		358	
Initial Properties	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm	241	227	196	154	235	182	245	190
300 rpm	147	143	121	95	147	110	150	116
200 rpm	111	110	92	72	108	82	113	86
100 rpm	70	70	59	46	67	51	70	53
6 rpm	12	15	11	10	13	11	13	11
3 rpm	8	11	8	7	10	8	9	8
Plastic Viscosity, cP	94	84	75	59	88	72	95	74
Yield Pt, lb/100ft^2	53	59	46	36	59	38	55	42
Gels, 10 sec/10 min.	8/10	11/14	8/9	7/8	9/10	9/9	9/10	8/9
Settling in thermocup	1	2	3	4	5	6	7	8
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm	300+	274	201	153	229	174	245	185
300 rpm	246	171	124	94	140	106	151	112
200 rpm	188	129	95	71	105	79	114	84
100 rpm	119	81	60	49	65	49	70	52
6 rpm	25	19	12	10	13	12	14	11
3 rpm	19	15	9	8	10	9	10	8
Plastic Viscosity, cP	-	103	77	59	89	68	94	73
Yield Pt, lb/100ft^2	-	68	47	35	51	38	57	39
Gels, 10 sec/10 min.	18/22	14/15	9/10	8/8	10/10	9/10	10/11	8/9
API filt, ml total	0.0		1.8		0.0		1.0	
API filt, ml oil	0.0		0.1		0.0		trace	
API filt, ml emulsion	0.0		1.7		0.0		1.0	
API filt, ml brine	0.0		0.0		0.0		0.0	
HTHP at 150°F, ml								
HTHP at 250°F, ml	1.2		7.4		4.8		4.4	
250°F oil	0.0		0.0		0.0		0.0	
250°F emulsion	1.2		7.4		4.8		4.4	
250°F brine	0.0		0.0		0.0		0.0	
Comments								
24 hrs at 75°F								
Total fluid heighth	38		38		38		38	
free oil heighth	0		0		0		0	
emusion heighth	38		38		38		38	
free brine heighth	0		0		0		0	
free oil, %	0		0		0		0	
emusion, %	100%		100%		100%		100%	
free brine, %	0		0		0		0	

Sample #	355	356	357	358
24 hrs at 150°F				
Total fluid heighth	38	38	38	38
free oil heighth	trace of oil	trace of oil	trace of oil	trace of oil
emusion heighth	38	38	38	38
free brine heighth	0	0	0	0
free oil, %	trace	trace	trace	trace
emusion, %	100%	100%	100%	100%
free brine, %	0	0	0	0

Sample #	353	354
IA - 35, grams	89.26	89.26
Cesium Formate, grams	445 (2.3)	445 (2.3)
Integrity Emulsifier, lb/bbl	25	25
Integrity Synvis, lb/bbl	0.5	0.5
Witco DTA 350, lb/bbl	-	0.5
Baroid Barablock, lb/bbl	-	-
M-I Lo Wate, lb/bbl	50	50

Initial ES, volts	301	295	384	387
Hot-rolled 16 hrs, ES	339	242	306	314

Initial Properties	120°F	150°F	120°F	150°F
600 rpm	203	155	224	171
300 rpm	122	92	138	104
200 rpm	90	68	103	77
100 rpm	53	41	65	47
6 rpm	7	7	10	8
3 rpm	5	5	7	7
Plastic Viscosity, cP	81	63	86	67
Yield Pt, lb/100ft^2	41	29	52	37
Gels, 10 sec/10 min.	6/6	5/6	7/8	7/7
Settling in thermocup	no	no	no	no

HR 16 hrs at 150°F	120°F	150°F	120°F	150°F
600 rpm	212	158	225	167
300 rpm	131	95	140	102
200 rpm	97	70	105	76
100 rpm	60	42	66	47
6 rpm	11	8	13	10
3 rpm	8	6	10	8

Sample #	**353**		**354**	
HR 16 hrs at 150°F				
Plastic Viscosity, cP	81	63	85	65
Yield Pt, lb/100ft^2	50	32	55	37
Gels, 10 sec/10 min.	8/9	6/6	10/10	8/8
API filt, ml total	0.3		1.8	
API filt, ml oil	-		0.1	
API filt, ml emulsion	0.3		1.7	
API filt, ml brine	-		-	
HTHP at 150°F, ml				
HTHP at 250°F, ml	4.8		3.6	
250°F oil	3.6		0.4	
250°F emulsion	1.2		3.2	
250°F brine	0.0		0.0	
Comments				
24 hrs at 75°F				
Total fluid heighth	38		38	
free oil heighth	0		0	
emusion heighth	38		38	
free brine heighth	0		0	
free oil, %	0		0	
emusion, %	100%		100%	
free brine, %	0		0	
24 hrs at 150°F				
Total fluid heighth	38		38	
free oil heighth	0		0	
emusion heighth	38		38	
free brine heighth	0		0	
free oil, %	0		0	
emusion, %	100%		100%	
free brine, %	0		0	
Sample #	**359**		**360**	
IA - 35, grams	84.26		84.26	
Cesium Formate, grams	445 (2.3)		445 (2.3)	
Integrity Emulsifier, lb/bbl	30		30	
Integrity Synvis, lb/bbl	0.5		0.5	
Witco DTA 350, lb/bbl	0.5		1.0	
Baroid Barablock, lb/bbl	10		-	
M-I Lo Wate, lb/bbl	50		50	
Initial ES, volts	440	492	457	481
Hot-rolled 16 hrs, ES	368	389	377	366

Sample #	359		360	
Initial Properties	120°F	150°F	120°F	150°F
600 rpm	300+	300+	261	219
300 rpm	253	233	167	142
200 rpm	196	182	129	109
100 rpm	127	119	84	70
6 rpm	28	29	14	12
3 rpm	20	22	9	8
Plastic Viscosity, cP	-	-	94	77
Yield Pt, lb/100ft^2	-	-	73	65
Gels, 10 sec/10 min.	19/22	22/26	9/11	8/10
Settling in thermocup	9	10	11	12
HR 16 hrs at 150°F	120°F	150°F	120°F	150°F
600 rpm	300+	300+	262	192
300 rpm	300+	242	168	123
200 rpm	282	186	131	95
100 rpm	181	121	86	64
6 rpm	42	32	20	14
3 rpm	32	26	15	11
Plastic Viscosity, cP	-	-	94	69
Yield Pt, lb/100ft^2	-	-	74	54
Gels, 10 sec/10 min.	32/33	25/27	14/15	10/12
API filt, ml total	0.0		0.3	
API filt, ml oil	0.0		trace	
API filt, ml emulsion	0.0		0.3	
API filt, ml brine	0.0		0.0	
HTHP at 150°F, ml				
HTHP at 250°F, ml	trace		3.6	
250°F oil	0.0		0.0	
250°F emulsion	trace		1.6	
250°F brine	0.0		2.0	
Comments				
24 hrs at 75°F				
Total fluid heighth	38		38	
free oil heighth	0		0	
emusion heighth	38		38	
free brine heighth	0		0	
free oil, %	0		0	
emusion, %	100%		100%	
free brine, %	0		0	

Sample #	359	360
24 hrs at 150°F		
Total fluid heighth	38	38
free oil heighth	0	0
emusion heighth	38	38
free brine heighth	0	0
free oil, %	0	0
emusion, %	100%	100%
free brine, %	0	0

		SA 250 Initial	SA 250 Silv.		SA 250 Initial	SA 250 Silv.		
Sample #	**349**	**349.5**	**349.75**	**350**	**350.5**	**350.75**	**351**	**352**
IA - 35, grams	94.26	94.26	94.26	94.26	94.26	94.26	94.26	94.26
Cesium Formate, grams	445	445	445	445	445	445	445	445
Integrity Emulsifier, lb/bbl	20	20	20	20	20	20	20	20
Integrity Synvis, lb/bbl	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Witco DTA 350, lb/bbl	-	-	-	0.5	0.5	0.5	0.5	1.0
Baroid Barablock, lb/bbl	-	-	-	-	-	-	10	-
M-I Lo Wate, lb/bbl	50	50	50	50	50	50	50	50
Initial ES, volts	227			256			301	283
Hot-rolled 16 hrs, ES	109			209			308	262
Static-aged ES, volts		113			154			
Initial Properties	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**
600 rpm	188	147	-	179	148	-	195	179
300 rpm	113	90	-	108	88	-	117	112
200 rpm	83	68	-	80	65	-	87	84
100 rpm	49	41	-	48	39	-	53	53
6 rpm	8	6	-	6	6	-	7	7
3 rpm	5	4	-	4	4	-	5	4
Plastic Viscosity, cP	75	57	-	71	60	-	78	67
Yield Pt, lb/100ft^2	38	33	-	37	28	-	39	45
Gels, 10 sec/10 min.	5/6	5/6	-	4/5	4/6	-	5/6	4/5
Settling in thermocup	no	no	-	no	no	-	no	no
HR 16 hrs at 150°F	**120°F**			**120°F**			**120°F**	**120°F**
600 rpm	187			196			300+	189
300 rpm	114			120			201	119
200 rpm	85			90			154	91
100 rpm	52			56			98	60
6 rpm	9			9			20	12
3 rpm	7			7			15	8

		SA 250 Initial	SA 250 Silv.		SA 250 Initial	SA 250 Silv.		
Sample #	349	349.5	349.75	350	350.5	350.75	351	352
HR 16 hrs at 150°F	120°F			120°F			120°F	120°F
Plastic Viscosity, cP	73			76			-	70
Yield Pt, lb/100ft^2	41			44			-	49
Gels, 10 sec/10 min.	7/7			6/8			14/19	8/10
Comments								
HR 16 hrs at 150°F	120°F			120°F			120°F	120°F
Initial ES, volts	253			266			300	365
Hot-rolled 16 hrs, ES	205	145	331	222	175	330	348	276
Initial Properties	150°F			150°F			150°F	150°F
600 rpm	138			134			193	146
300 rpm	81			80			120	92
200 rpm	59			59			91	70
100 rpm	35			35			56	43
6 rpm	6			5			10	6
3 rpm	5			4			7	4
Plastic Viscosity, cP	57			54			73	54
Yield Pt, lb/100ft^2	24			26			47	38
Gels, 10 sec/10 min.	5/5			4/5			8/9	5/5
Settling in thermocup	no			no			no	no
		SA 250 Initial	SA 250 Silv.		SA 250 Initial	SA 250 Silv.		
HR 16 hrs at 150°F	150°F	150°F	150°F	150°F	150°F	150°F	150°F	150°F
600 rpm	137	98	121	137	104	121	226	143
300 rpm	81	58	70	82	60	70	140	90
200 rpm	60	42	51	61	44	51	106	69
100 rpm	36	25	30	37	26	30	67	44
6 rpm	7	4	5	7	5	5	15	9
3 rpm	5	3	3	5	3	3	11	6
Free Oil, %			22%			25%		

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		SA 250 Initial	SA 250 Silv.		SA 250 Initial	SA 250 Silv.	
Sample #	**353**	**353.5**	**353.75**	**354**	**354.5**	**354.75**	**355**
IA - 35, grams	89.26	89.26	89.26	89.26	89.26	89.26	89.26
Cesium Formate, grams	445	445	445	445	445	445	445
Integrity Emulsifier, lb/bbl	25	25	25	25	25	25	25
Integrity Synvis, lb/bbl	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Witco DTA 350, lb/bbl	-	-	-	0.5	0.5	0.5	0.5
Baroid Barablock, lb/bbl	-	-	-	-	-	-	10
M-I Lo Wate, lb/bbl	50	50	50	50	50	50	50
Initial ES, volts	301			384			357
Hot-rolled 16 hrs, ES	339			306			328
Static-aged ES, volts		150			240		
Initial Properties	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**
600 rpm	203	159	-	224	205	-	241
300 rpm	122	97	-	138	125	-	147
200 rpm	90	73	-	103	93	-	111
100 rpm	53	44	-	65	56	-	70
6 rpm	7	7	-	10	9	-	12
3 rpm	5	5	-	7	7	-	8
Plastic Viscosity, cP	81	62	-	86	80	-	94
Yield Pt, lb/100ft^2	41	35	-	52	45	-	53
Gels, 10 sec/10 min.	6/6	6/7	-	7/8		-	8/10
Settling in thermocup	no	no	-	no	no	-	1
HR 16 hrs at 150°F	**120°F**			**120°F**			**120°F**
600 rpm	212			225			300+
300 rpm	131			140			246
200 rpm	97			105			188
100 rpm	60			66			119
6 rpm	11			13			25
3 rpm	8			10			19
Plastic Viscosity, cP	81			85			-
Yield Pt, lb/100ft^2	50			55			-
Gels, 10 sec/10 min.	8/9			10/10			18/22
Comments							
HR 16 hrs at 150°F	**120°F**			**120°F**			**120°F**
Initial ES, volts	295			387			365
Hot-rolled 16 hrs, ES	242	161	369	314	218	336	325

Sample #	353	353.5	353.75	354	354.5	354.75	355
Initial Properties	150°F			150°F			150°F
600 rpm	155			171			227
300 rpm	92			104			143
200 rpm	68			77			110
100 rpm	41			47			70
6 rpm	7			8			15
3 rpm	5			7			11
Plastic Viscosity, cP	63			67			84
Yield Pt, lb/100ft^2	29			37			59
Gels, 10 sec/10 min.	5/6			7/7			11/14
Settling in thermocup	no			no			no

		SA 250 Initial	SA 250 Silv.		SA 250 Initial	SA 250 Silv.	
HR 16 hrs at 150°F	150°F	150°F	150°F	150°F	150°F	150°F	150°F
600 rpm	158	114	136	167	133	157	274
300 rpm	95	68	80	102	78	94	171
200 rpm	70	50	59	76	57	69	129
100 rpm	42	30	35	47	34	41	81
6 rpm	8	5	7	10	6	6	19
3 rpm	6	4	5	8	4	4	15
Free Oil, %			25%			25%	

Sample #	356	357	358	359	360
IA - 35, grams	89.26	84.26	84.26	84.26	84.26
Cesium Formate, grams	445	445	445	445	445
Integrity Emulsifier, lb/bbl	25	30	30	30	30
Integrity Synvis, lb/bbl	0.5	0.5	0.5	0.5	0.5
Witco DTA 350, lb/bbl	1.0	-	0.5	0.5	1.0
Baroid Barablock, lb/bbl	-	-	-	10	-
M-I Lo Wate, lb/bbl	50	50	50	50	50
Initial ES, volts	329.	335	344	440	457
Hot-rolled 16 hrs, ES	307	298	301	368	377
Static-aged ES, volts					
Initial Properties	120°F	120°F	120°F	120°F	120°F
600 rpm	196	235	245	300+	261
300 rpm	121	147	150	253	167
200 rpm	92	108	113	196	129
100 rpm	59	67	70	127	84

Sample #	**356**	**357**	**358**	**359**	**360**
6 rpm	11	13	13	28	14
3 rpm	8	10	9	20	9
Plastic Viscosity, cP	75	88	95	-	94
Yield Pt, lb/100ft^2	46	59	55	-	73
Gels, 10 sec/10 min.	8/9	9/10	9/10	19/22	9/11
Settling in thermocup	3	5	7	9	11
HR 16 hrs at 150°F	**120°F**	**120°F**	**120°F**	**120°F**	**120°F**
600 rpm	201	229	245	300+	262
300 rpm	124	140	151	300+	168
200 rpm	95	105	114	282	131
100 rpm	60	65	70	181	86
6 rpm	12	13	14	42	20
3 rpm	9	10	10	32	15
Plastic Viscosity, cP	77	89	94	-	94
Yield Pt, lb/100ft^2	47	51	57	-	74
Gels, 10 sec/10 min.	9/10	10/10	10/11	32/33	14/15
Comments					
HR 16 hrs at 150°F	**120°F**	**120°F**			
Initial ES, volts	311	316	321	492	481
Hot-rolled 16 hrs, ES	307	301	272	389	366
Initial Properties	**150°F**	**150°F**	**150°F**	**150°F**	**150°F**
600 rpm	154	182	190	300+	219
300 rpm	95	110	116	233	142
200 rpm	72	82	86	182	109
100 rpm	46	51	53	119	70
6 rpm	10	11	11	29	12
3 rpm	7	8	8	22	8
Plastic Viscosity, cP	59	72	74	-	77
Yield Pt, lb/100ft^2	36	38	42	-	65
Gels, 10 sec/10 min.	7/8	9/9	8/9	22/26	8/10
Settling in thermocup	no	no	no	no	no
HR 16 hrs at 150°F	**150°F**	**150°F**	**150°F**	**150°F**	**150°F**
600 rpm	153	174	185	300+	192
300 rpm	94	106	112	242	123
200 rpm	71	79	84	186	95
100 rpm	49	49	52	121	64
6 rpm	10	12	11	32	14
3 rpm	8	9	8	26	11
Free Oil, %					

Cesium formate, IA - 35 (50/50 mixture, 2.3 s.g. CsF)

Mixing Procedure: **2.3 sg csf**

1. Measure out IA - 35
1A. Add Synvis, mix 5 minutes
2. Add CsF, mix 10 min.
3. Add Synvert 5, mix 10 minutes
3A. Add calcium carbonate, mix 10 minutes
4. Run initial ES, viscosities at 120°F
5. Put 10 ml sample in a vial, SA for 24 hrs at 75°F, measure volumes
6. Hot-roll for 16 hours at 150°F
7. Remix, run rheology, ES, API, HTHP at 150°F
8. Put vials in oven and static-age at 150°F for 24 hrs, measure volumes
9. If 150°F HTHP is good, run at 250°F

41.6/58.4 oil/csf ratio

Sample #	337		338		339		340	
IA - 35, grams	98.26		98.26		93.26		93.26	
Cesium Formate, grams	445 (2.366)		445 (2.366)		445 (2.366)		445 (2.366)	
Integrity Emulsifier, lb/bbl	25		25		20		20	
Integrity Synvis, lb/bbl	0.5		1		0.5		1	
Witco DTA 350, lb/bbl	-		-		-		-	
Baroid Baracarb 50, lb/bbl	50		50		50		50	
Initial ES, volts	103	129	167	166	114	151	117	128
Hot-rolled 16 hrs, ES	114	102	148	140	139	138	122	118
Initial Properties	120°F	150°F	120°F	150°F	120°F	150°F	120°F	150°F
600 rpm	162	116	186	118	164	115	183	126
300 rpm	93	65	114	67	96	66	109	73
200 rpm	67	47	83	49	70	48	80	53
100 rpm	40	27	49	29	41	28	47	31
6 rpm	8	7	9	6	7	6	8	6
3 rpm	6	5	7	5	5	5	6	5
Plastic Viscosity, cP	69	51	72	51	68	49	74	53
Yield Pt, lb/100ft^2	24	14	42	16	28	17	35	20
Gels, 10 sec/10 min.	6/7	6/6	6/7	5/6	5/6	5/5	6/7	5/5
Settling in thermocup	no	no	no	no	no	no	no	no
HR 16 hrs at 150°F	120°F	150°F	120°F	150°F	120°F	150°F	120°F	150°F
600 rpm	161	113	187	123	162	114	184	129
300 rpm	93	64	116	70	97	66	111	75
200 rpm	68	46	86	52	72	48	82	55
100 rpm	39	27	52	30	473	28	49	32
6 rpm	8	6	10	6	7	6	8	6
3 rpm	6	5	8	5	5	4	6	5

Sample #	337		338		339		340	
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
Plastic Viscosity, cP	68	49	71	53	65	48	73	56
Yield Pt, lb/100ft^2	25	15	45	17	32	18	38	28
Gels, 10 sec/10 min.	6/6	5/6	7/9	5/6	6/6	5/5	6/7	5/6
API filt, ml total	1.0		0.2		0.4		0.3	
API filt, ml oil	-		-		-		-	
API filt, ml emulsion	1.0		0.2		0.4		0.3	
API filt, ml brine	-		-		-		-	
HTHP at 150°F, ml					0.2		0.2	
HTHP at 250°F, ml					11.4		4.4	
250°F oil					0.0		0.0	
250°F emulsion					6.8		3.2	
250°F brine					4.6		1.2	
Comments								

NOTE: **1. Sample 337 and 338 looked grainy with 15 lb/bbl Synvert V. Concentration was increased to 25 lb/bbl. After hot-rolling at 150°F, #337 and #338 still appear grainy.**

2. Mud weight of 339 is 14.7 lb/gal (CsF in 337-340 is 2.366 s.g)

41.6/58.4 oil/csf ratio

Sample #	347	348	341	342	343	344	345	346
IA - 35, grams	88.26	88.26	88.26	88.26	98.26	98.26	93.26	93.26
Cesium Formate, grams	445 (2.3)	445 (2.3)	445	445	445	445	445	445
Integrity Emulsifier, lb/bbl	25	25	25	25	15	15	20	20
Integrity Synvis, lb/bbl	-	-	0.5	1	-	-	-	-
Witco DTA 350, lb/bbl	0.5	1	-	-	0.5	1	0.5	1
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50	50	50

Initial ES, volts	212	192	205	243
Hot-rolled 16 hrs, ES	148	145	252	247

Initial Properties	120°F	150°F	120°F	150°F
600 rpm	177	132	182	132
300 rpm	106	78	111	80
200 rpm	77	57	83	61
100 rpm	46	347	52	38
6 rpm	8	7	10	8
3 rpm	6	5	7	6
Plastic Viscosity, cP	71	54	71	52
Yield Pt, lb/100ft^2	35	24	40	28
Gels, 10 sec/10 min.	6/6	6/6	8/8	6/7
Settling in thermocup	no	no	no	no

HR 16 hrs at 150°F	120°F	150°F	120°F	150°F
600 rpm	179	140	184	144
300 rpm	109	84	113	88
200 rpm	80	62	85	66
100 rpm	48	37	52	41
6 rpm	8	7	10	9
3 rpm	6	5	8	7

Sample #	**347**		**348**	
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**
Plastic Viscosity, cP	70	56	71	56
Yield Pt, lb/100ft^2	39	32	42	32
Gels, 10 sec/10 min.	6/6	5/5	8/8	7/9
API filt, ml total	3.5		6.2	
API filt, ml oil	-		-	
API filt, ml emulsion	3.5		6.2	
API filt, ml brine	-		-	
HTHP at 150°F, ml	19.4	(0.8 brine)		
HTHP at 250°F, ml				
250°F oil				
250°F emulsion				
250°F brine				
Comments				

3. Mud weight of 347 is 14.6 lb/gal (CsF in 347-348 is 2.30 s.g)

Cesium formate, IA - 35 (50/50 mixture)

175 ml IA - 35 (0.828 sg) - (144.9 grams)
175 ml Cesium Formate (2.2 sg) - (385 grams)

Mixing Procedure:

1. Measure out IA - 35
1A. Add Synvis, mix 5 minutes
2. Add CsF, mix 10 min.
3. Add Synvert 5, mix 10 minutes
3A. Add calcium carbonate, mix 10 minutes
4. Run initial ES, viscosities at 120°F
5. Put 10 ml sample in a vial, SA for 24 hrs at 75°F, measure volumes
6. Hot-roll for 16 hours at 150°F
7. Remix, run rheology, ES, API, HTHP at 150°F
8. Put vials in oven and static-age at 150°F for 24 hrs, measure volumes
9. If 150°F HTHP is good, run at 250°F

50/50 ratio
Mud weight, 13.1 lb/gal

Sample #	313	314	314A	314B	315	316	317	318
IA - 35, grams	134.9	134.9	134.9	134.9	134.9	134.9	134.9	134.9
Cesium Formate, grams	385	385	385	385	385	385	385	385
Integrity Emulsifier, lb/bbl	10	10	15	20	10	10	10	10
Integrity Synvis, lb/bbl	0.5	0.5	0.5	0.5	0.5	0.5	1	1
Witco DTA 350, lb/bbl	1	1.25	1.125	1.125	1.5	1.75	1	1.25
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50	50	50
Initial ES, volts	330	332	353	355	437	402	298	330
Hot-rolled 16 hrs, ES	416	343	284	290	396	427	344	396
Initial Properties								
600 rpm at 120°F	89	102	70	72	108	120	91	104
300 rpm	58	66	40	39	78	83	59	70
200 rpm	47	53	30	28	66	70	48	57
100 rpm	35	42	19	16	53	56	36	44
6 rpm	20	26	4	2	32	31	20	25
3 rpm	17	21	3	1	26	19	18	22
Plastic Viscosity, cP	31	36	30	33	30	37	32	34
Yield Pt, lb/100ft^2	27	30	10	6	48	46	27	36
Gels, 10 sec/10 min.	23/19	25/25	4/9	2/3	19/25	19/19	17/23	23/27
Settling in thermocup	No	No	No	No	No	No	No	No

Sample #	313	314	314A	314B	315	316	317	318
HR 16 hrs at 150°F								
600 rpm at 120°F	93	93	82	73	93	95	113	124
300 rpm	67	67	54	40	67	69	81	93
200 rpm	57	57	44	29	58	60	69	81
100 rpm	46	47	34	17	48	49	55	67
6 rpm	23	25	14	3	28	27	22	32
3 rpm	17	19	10	2	20	19	18	24
Plastic Viscosity, cP	26	26	28	33	26	26	32	31
Yield Pt, lb/100ft^2	41	41	26	7	41	43	49	62
Gels, 10 sec/10 min.	19/23	21/21	12/15	3/4	23/23	21/19	21/26	26/21
API filt, ml total	1.2	1.8	5.8	2.6	2.2	1.2	0.2	3
API filt, ml oil	0.8	1	0.7	0.6	1	0.2	0.1	0.9
API filt, ml emulsion	0.4	0.8	5.1	2.0	1.2	1	0.1	2.1
API filt, ml brine	0	0	0	0	0	0	0	0
HTHP at 150°F, ml								
HTHP at 250°F, ml								
Comments		oil on top of jar			oil on top of jar	oil on top of jar		
24 hrs at 75°F								
Total fluid heighth	38	38			38	38	38	38
free oil heighth	0.1	1.0			0.1	0.1	0.1	0.1
emusion heighth	38	37			38	38	38	38
free brine heighth	0	0			0	0	0	0
free oil, %	0.3%	2.6%			0.3%	0.3%	0.3%	0.3%
emusion, %	100.0%	97.4%			100.0%	100.0%	100.0%	100.0%
free brine, %	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%
24 hrs at 150°F								
Total fluid heighth	38	38			38	38	38	38
free oil heighth	4	4			3	3	2	2
emusion heighth	34	34			35	35	36	36
free brine heighth	0	0			0	0	0	0
free oil, %	10.5%	10.5%			7.9%	7.9%	5.3%	5.3%
emusion, %	89.5%	89.5%			92.1%	92.1%	94.7%	94.7%
free brine, %	0.0%	0.0%			0.0%	0.0%	0.0%	0.0%
72 hrs at 150°F								
Total fluid heighth								
free oil heighth								
emusion heighth								
free brine heighth								
free oil, %								
emusion, %								
free brine, %								

50/50 ratio Mud weight, 13.1 lb/gal Sample #	319	320	321	322	323	324
IA - 35, grams	134.9	134.9	134.9	134.9	134.9	134.9
Cesium Formate, grams	385	385	385	385	385	385
Integrity Emulsifier, lb/bbl	10	10	10	10	10	10
Integrity Synvis, lb/bbl	1	1	1.5	1.5	1.5	1.5
Witco DTA 350, lb/bbl	1.5	1.75	1	1.25	1.5	1.75
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50
Initial ES, volts	309	377	245	282	263	358
Hot-rolled 16 hrs, ES	346	355	324	268	380	382
Initial Properties						
600 rpm at 120°F	115	111	91	117	127	136
300 rpm	77	78	52	74	85	97
200 rpm	64	64	38	59	70	82
100 rpm	49	49	23	43	54	66
6 rpm	27	27	7	23	30	36
3 rpm	22	22	6	19	24	28
Plastic Viscosity, cP	38	33	39	43	42	39
Yield Pt, lb/100ft^2	39	45	13	31	43	58
Gels, 10 sec/10 min.	24/24	23/26	7/12	21/26	26/29	29/29
Settling in thermocup	No	No	No	No	No	No
HR 16 hrs at 150°F						
600 rpm at 120°F	122	118	133	140	147	148
300 rpm	90	90	98	101	111	111
200 rpm	78	79	83	86	96	97
100 rpm	64	65	68	69	78	78
6 rpm	32	32	28	31	34	34
3 rpm	23	23	22	23	25	25
Plastic Viscosity, cP	32	28	35	39	36	37
Yield Pt, lb/100ft^2	58	62	63	62	75	74
Gels, 10 sec/10 min.	24/19	21/18	25/31	27/258	26/26	28/26
API filt, ml total	2	1.5	2.3	2.4	1.0	0.8
API filt, ml oil	1	1	0.5	0.8	0.3	0.6
API filt, ml emulsion	1	0.5	1.8	1.6	0.7	0.2
API filt, ml brine	0	0	0	0	0	0
HTHP at 150°F, ml						
HTHP at 250°F, ml						
Comments	oil on top of jar	oil on top of jar				
24 hrs at 75°F						
Total fluid heighth	38	38	38	38	38	38
free oil heighth	0.1	0.1	1.0	0.1	0.1	0.1
emusion heighth	38	38	37	38	38	38
free brine heighth	0	0	0	0	0	0
free oil, %	0.3%	0.3%	2.6%	0.3%	0.3%	0.3%
emusion, %	100.0%	100.0%	97.4%	100.0%	100.0%	100.0%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Sample #	319	320	321	322	323	324
HR 16 hrs at 150°F						
24 hrs at 150°F						
Total fluid heighth	38	38	38	38	38	38
free oil heighth	3	2	4	3	2	2
emusion heighth	35	36	34	35	36	36
free brine heighth	0	0	0	0	0	0
free oil, %	7.9%	5.3%	10.5%	7.9%	5.3%	5.3%
emusion, %	92.1%	94.7%	89.5%	92.1%	94.7%	94.7%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Cesium formate, IA - 35 (50/50 mixture)

175 ml IA - 35 (0.828 sg) - (144.9 grams)
175 ml Cesium Formate (2.2 sg) - (385 grams)

Mixing Procedure:							
						529.9	350
	2.2 sg		331.4				
1. Measure out IA - 35	**csf**	559.24	8			**50**	18.52
						13.1080	
1A. Add Synvis, mix 5 minutes		50	18.52			2	
2. Add CsF, mix 10 min.		609.24	350	1.740686			22.5
3. Add Synvert 5, mix 10 minutes		1.6871					2.70108
			0.373				
3A. Add calcium carbonate, mix 10 minutes		0.828	5	0.309258			
			0.626				
4. Run initial ES, viscosities at 120°F		2.2	5	1.3783			
5. Put 10 ml sample in a vial, SA				1.687558			
for 24 hrs at 75°F, measure volumes							
			559.2				
6. Hot-roll for 16 hours at 150°F		**2.3 sg csf**	4	331.48			
7. Remix, run rheology, ES, API, HTHP at 150°F			50	18.52			
			609.2			14.4999	
8. Put vials in oven and static-age at 150°F			4	350	1.740686	1	
			1.687				
for 24 hrs, measure volumes			1				
9. If 150°F HTHP is good, run at 250°F			0.828	0.4163	0.344696		
			2.3	0.5837	1.34251		
					1.687206		
				Additional 0.5 lb/bbl			
						137.995	
						1	114.26
						193.484	445.015
						9	2

37/63 Oil/Formate ratio							**H.R. 16 hrs**	
14.4 lb/gal							**at 250°F**	
Sample #	**325**	**326**	**327**	**328**	**329**	**329**	**329**	**330**
IA - 35, grams	87.5	87.5	87.5	87.5	87.5	87.5	87.5	87.5
Cesium Formate, grams	456.9	456.9	456.9	456.9	456.9	456.9	456.9	456.9
Integrity Emulsifier, lb/bbl	15	15	15	15	15	15	15	15
Integrity Synvis, lb/bbl	-	1	2	2	1	1	1	-
Witco DTA 350, lb/bbl	-	1	1	2	-	-	-	1
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50	50	50
Initial ES, volts	167	395	413	443	303	303		378
Hot-rolled 16 hrs, ES	221	372	377	488	284	284	259	324
Initial Properties							**120°F**	
600 rpm at 120°F	163	233	300+	300+	251		247	177
300 rpm	97	142	210	300+	154		156	106
200 rpm	71	107	162	253	116		121	78
100 rpm	42	64	104	185	71		71	46
6 rpm	6	9	22	66	11		13	5
3 rpm	4	6	16	53	8		10	3

Sample #	325	326	327	328	329	329	329	330
Plastic Viscosity, cP	66	91	-	-	97		91	71
Yield Pt, lb/100ft^2	31	51	-	-	57		65	35
Gels, 10 sec/10 min.	4/5	6/7	15/18	53/81	7/9		10/18	3/4
Settling in thermocup								slight sag
HR 16 hrs at 150°F						150°F	150°F	
600 rpm at 120°F	177	267	300+	300+	273	179	165	200
300 rpm	108	177	260	300+	180	114	101	128
200 rpm	80	137	208	300+	140	87	76	99
100 rpm	48	92	140	252	91	54	46	65
6 rpm	8	21	40	98	20	10	8	15
3 rpm	5	16	32	80	15	7	6	11
Plastic Viscosity, cP	69	90	-	-	93	65	64	72
Yield Pt, lb/100ft^2	39	87	-	-	87	49	37	56
Gels, 10 sec/10 min.	5/6	15/33	30/57	80/114	14/17	7/8	6/6	10/11
API filt, ml total	0.7	0.8	0	0	0			9
API filt, ml oil	0	0	0	0	0			0
API filt, ml emulsion	0.7	0.8	0	0	0			9
API filt, ml brine								
HTHP at 150°F, ml								
HTHP at 250°F, ml						12.6	7.2	
250°F oil						0	0	
250°F emulsion						11.8	6.4	
250°F brine						0.8	0.8	
Comments								
24 hrs at 75°F								
Total fluid heighth	39	38	38	38	38			38
free oil heighth	1.0	0.0	0.0	0.0	0.0			0.0
emusion heighth	38	38	38	38	38			38
free brine heighth	0	0	0	0	0			0
free oil, %								
emusion, %								
free brine, %								
24 hrs at 150°F								
Total fluid heighth								
free oil heighth								
emusion heighth								
free brine heighth								
free oil, %								
emusion, %								
free brine, %								
72 hrs at 150°F								
Total fluid heighth								
free oil heighth								
emusion heighth								
free brine heighth								
free oil, %								
emusion, %								
free brine, %								

37/63 Oil/Formate ratio **14.4 lb/gal**				**Hot roll** **16 hrs** **at 250°F**				
Sample #	**331**	**332**	**332**	**332**	**333**		**334**	
IA - 35, grams	82.5	82.5	82.5	82.5	82.5		82.5	
Cesium Formate, grams	456.9	456.9	456.9	456.9	456.9		456.9	
Integrity Emulsifier, lb/bbl	20	20	20	20	20		20	
Integrity Synvis, lb/bbl	-	1	1	1	-		0.5	
Witco DTA 350, lb/bbl	1	-	-	-	-		-	
Baroid Baracarb 50, lb/bbl	50	50	50	50	50		50	
Initial ES, volts	427	285	285		351	337	310	277
Hot-rolled 16 hrs, ES	391	363	363	293				
Initial Properties				**120°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm at 120°F	223	247		273	218	170	230	170
300 rpm	137	152		172	132	103	139	103
200 rpm	104	14		131	98	76	104	76
100 rpm	63	69		83	59	46	62	46
6 rpm	9	12		15	8	8	9	8
3 rpm	5	8		11	6	5	6	5
Sample #								
Plastic Viscosity, cP	86	95		101	86	67	91	67
Yield Pt, lb/100ft^2	51	57		71	46	36	48	36
Gels, 10 sec/10 min.	5/6	8/9		12/15	6/7	6/6	6/7	6/6
Settling in thermocup								
HR 16 hrs at 150°F			**150°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm at 120°F	223	280	186	174	222	179	245	176
300 rpm	140	179	117	103	139	112	155	111
200 rpm	106	138	89	76	106	86	119	83
100 rpm	66	89	55	45	67	54	76	52
6 rpm	11	19	11	8	13	11	15	10
3 rpm	7	14	8	6	9	8	10	7
Plastic Viscosity, cP	83	101	69	71	83	67	90	65
Yield Pt, lb/100ft^2	57	78	48	32	56	45	65	46
Gels, 10 sec/10 min.	7/8	14/18	8/9	6/7	9/10	8/9	10/15	7/8
API filt, ml total	3.5	0			1.1		0.3	
API filt, ml oil	0	0			0.0		0.0	
API filt, ml emulsion	3.5	0			1.1		0.3	
API filt, ml brine								
HTHP at 150°F, ml								
HTHP at 250°F, ml			11.4	9.6	40.0		23.2	
250°F oil			0	0	0.0		0.0	
250°F emulsion			11.4	8.6	36.0		21.2	
250°F brine			0.6	1.0	4.0		2.0	
Comments								
24 hrs at 75°F								
Total fluid heighth	38	38						
free oil heighth	0.0	0.0						
emusion heighth	38	38						
free brine heighth	0	0						

37/63 Oil/Formate ratio								
14.4 lb/gal					**Synvis added after h.r.**			
Sample #	**335**		**336**		**334A**		**336A**	
IA - 35, grams	82.5		82.5		82.5		82.5	
Cesium Formate, grams	456.9		456.9		456.9		456.9	
Integrity Emulsifier, lb/bbl	25		25		20		25	
Integrity Synvis, lb/bbl	-		0.5		1.0		1.0	
Witco DTA 350, lb/bbl	-		-		-		-	
Baroid Baracarb 50, lb/bbl	50		50		50		50	
Initial ES, volts	400	278	337	344	405	297	381	312
Hot-rolled 16 hrs, ES					297	313	312	353
Initial Properties	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm at 120°F	245	192	264	206	300+	219	300+	227
300 rpm	151	119	162	127	194	135	197	141
200 rpm	114	90	122	96	151	102	150	108
100 rpm	70	56	75	59	96	63	94	68
6 rpm	12	10	14	12	18	12	18	14
3 rpm	8	7	10	9	13	8	13	11
Sample #								
Plastic Viscosity, cP	94	73	102	79	-	84	-	86
Yield Pt, lb/100ft^2	57	46	60	48	-	51	-	55
Gels, 10 sec/10 min.	8/9	8/9	10/11	9/10	12/16	8/9	13/17	11/11
Settling in thermocup								
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm at 120°F	241	192	264	210	300+	200	297	220
300 rpm	152	123	169	133	200	127	191	141
200 rpm	116	94	129	103	157	97	148	109
100 rpm	73	60	83	66	104	62	97	70
6 rpm	15	14	18	15	25	13	22	16
3 rpm	11	10	13	11	20	10	17	12
Plastic Viscosity, cP	89	69	95	77	-	73	106	79
Yield Pt, lb/100ft^2	63	54	74	56	-	54	85	62
Gels, 10 sec/10 min.	11/12	10/11	13/20	11/12	18/24	10/11	16/22	12/13
API filt, ml total	1.4		0.2		-		0.2	
API filt, ml oil	0.0		0.0		-		0.0	
API filt, ml emulsion	1.4		0.2		-		0.2	
API filt, ml brine								
HTHP at 150°F, ml								
HTHP at 250°F, ml	45.6		27.6		12.0		12.0	
250°F oil	0.0		0.0		0.0		0.0	
250°F emulsion	35.6		27.0		10.0		11.0	
250°F brine	10.0		0.6		2.0		1.0	
Comments								

37/63 Oil/Formate ratio **14.4 lb/gal**					**0.5 lb/bbl Synvis** **added after h.r.**			
Sample #	**333**		**334**		**334A**		**335**	
IA - 35, grams	82.5		82.5		82.5		82.5	
Cesium Formate, grams	456.9		456.9		456.9		456.9	
Integrity Emulsifier, lb/bbl	20		20		20		25	
Integrity Synvis, lb/bbl	-		0.5		1.0		-	
Witco DTA 350, lb/bbl	-		-		-		-	
Baroid Baracarb 50, lb/bbl	50		50		50		50	
Initial ES, volts	351	337	310	277	405	297	400	278
Hot-rolled 16 hrs, ES					297	313		
Initial Properties	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm at 120°F	218	170	230	170	300+	219	245	192
300 rpm	132	103	139	103	194	135	151	119
200 rpm	98	76	104	76	151	102	114	90
100 rpm	59	46	62	46	96	63	70	56
6 rpm	8	8	9	8	18	12	12	10
3 rpm	6	5	6	5	13	8	8	7
Plastic Viscosity, cP	86	67	91	67	-	84	94	73
Yield Pt, lb/100ft^2	46	36	48	36	-	51	57	46
Gels, 10 sec/10 min.	6/7	6/6	6/7	6/6	12/16	8/9	8/9	8/9
Settling in thermocup								
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm at 120°F	222	179	245	176	300+	200	241	192
300 rpm	139	112	155	111	200	127	152	123
200 rpm	106	86	119	83	157	97	116	94
100 rpm	67	54	76	52	104	62	73	60
6 rpm	13	11	15	10	25	13	15	14
3 rpm	9	8	10	7	20	10	11	10
Plastic Viscosity, cP	83	67	90	65	-	73	89	69
Yield Pt, lb/100ft^2	56	45	65	46	-	54	63	54
Gels, 10 sec/10 min.	9/10	8/9	10/15	7/8	18/24	10/11	11/12	10/11
API filt, ml total	1.1		0.3		-		1.4	
API filt, ml oil	0.0		0.0		-		0.0	
API filt, ml emulsion	1.1		0.3		-		1.4	
API filt, ml brine								
HTHP at 150°F, ml								
HTHP at 250°F, ml	40.0		23.2		12.0		45.6	
250°F oil	0.0		0.0		0.0		0.0	
250°F emulsion	36.0		21.2		10.0		35.6	
250°F brine	4.0		2.0		2.0		10.0	

37/63 Oil/Formate ratio **14.4 lb/gal**			**0.5 lb/bbl Synvis** **added after h.r.**	
Sample #	**336**		**336A**	
IA - 35, grams	82.5		82.5	
Cesium Formate, grams	456.9		456.9	
Integrity Emulsifier, lb/bbl	25		25	
Integrity Synvis, lb/bbl	0.5		1.0	
Witco DTA 350, lb/bbl	-		-	
Baroid Baracarb 50, lb/bbl	50		50	
Initial ES, volts	337	344	381	312
Hot-rolled 16 hrs, ES			312	353
Initial Properties	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm at 120°F	264	206	300+	227
300 rpm	162	127	197	141
200 rpm	122	96	150	108
100 rpm	75	59	94	68
6 rpm	14	12	18	14
3 rpm	10	9	13	11
Plastic Viscosity, cP	102	79	-	86
Yield Pt, lb/100ft^2	60	48	-	55
Gels, 10 sec/10 min.	10/11	9/10	13/17	11/11
Settling in thermocup				
HR 16 hrs at 150°F	**120°F**	**150°F**	**120°F**	**150°F**
600 rpm at 120°F	264	210	297	220
300 rpm	169	133	191	141
200 rpm	129	103	148	109
100 rpm	83	66	97	70
6 rpm	18	15	22	16
3 rpm	13	11	17	12
Plastic Viscosity, cP	95	77	106	79
Yield Pt, lb/100ft^2	74	56	85	62
Gels, 10 sec/10 min.	13/20	11/12	16/22	12/13
API filt, ml total	0.2		0.2	
API filt, ml oil	0.0		0.0	
API filt, ml emulsion	0.2		0.2	
API filt, ml brine				
HTHP at 150°F, ml				
HTHP at 250°F, ml	27.6		12.0	
250°F oil	0.0		0.0	
250°F emulsion	27.0		11.0	
250°F brine	0.6		1.0	
Comments				

Cesium formate, Escaid 110 (50/50 mixture)

175 ml Escaid 110 (0.803 sg) - (140.5 grams)
175 ml Cesium Formate (2.2 sg) - (385 grams)

Mixing Procedure:

1. Measure out Escaid 110
2. Add emulsifiers, mix 5 minutes
3. Add CsF, mix 10 min. on HB, mix on Silverson to 135°F
3A. Add Lo-Wate, mix 10 min. on HB
4. Run initial ES, viscosities at 120°F
5. Put 10 ml sample in a vial, SA for 24 hrs at 75°F, measure volumes
6. Hot-roll for 16 hours at 150°F
7. Remix, run rheology, ES, API, HTHP at 150°F
8. Put vials in oven and static-age at 150°F for 24 hrs, measure volumes
9. If 150°F HTHP is good, run at 250°F

Sample #	273	274	275	276	277	278
Integrity Synvert IV (Lot# 000329), lb/bbl	5	10	10	10	15	15
Witco AX-180-2, lb/bbl	5	5	5	5	5	5
Witco DTA 350, lb/bbl dimer trimer			2	3		2
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50
Initial ES, volts @ 120°F	363	360	425	572	454	417
Hot-rolled 16 hrs, ES	399	410	378	489	403	329
Jar - S = Settling, 3 = 3 Phases, N = No	S 3	S 3	S	S 3	S	S
Initial Properties						
600 rpm at 120°F	24	25	29	42	27	29
300 rpm	13	14	17	30	15	15
200 rpm	9	9	12	25	10	11
100 rpm	5	5	8	19	6	6
6 rpm	1	1	2	10	2	1
3 rpm	1	1	1	7	1	1
Plastic Viscosity, cP	11	11	12	12	12	14
Yield Pt, lb/100ft^2	2	3	5	18	3	1
Gels, 10 sec/10 min.	1/1	1/1	2/2	7/8	1/2	1/1
Settling in thermocup	Y	Y	Y	N	Y	Y
HR 64 hrs at 150°F						
600 rpm at 120°F	24	26	31	54	28	28
300 rpm	12	13	18	40	15	15
200 rpm	8	9	14	34	11	11
100 rpm	5	5	9	28	7	6
6 rpm	1	1	3	19	2	1
3 rpm	1	1	2	11	2	1
Plastic Viscosity, cP	12	13	13	14	13	13
Yield Pt, lb/100ft^2	0	0	5	26	2	2
Gels, 10 sec/10 min.	1/1	1/1	2/2	14/8	2/2	1/1
Settling in Thermocup	Y	Y	N	N	Y	Y
Settling in Jar	1/4"	1/8"	1/16"	-	1/16"	1/8"
API filt, ml total	3.2	1.8	2.0	2.0	1.4	2.6
API filt, ml oil	1.6	1.6	2.0	2.0	0.4	2.6
API filt, ml brine	1.6	0.2	0.0	0.0	1.0	0.0
HTHP at 150°F, ml	8.6	6.6	8.6	8.0	9.8	13.4
HTHP at 250°F, ml		17.2		29.0		

Sample #	273	274	275	276	277	278
Static Age - 64 hrs at 75°F						
Total fluid height	32	32	32	32	32	32
free oil height	4	3	7	7	2	3
emusion height	28	29	25	25	30	29
free brine height	0	0	0	0	0	0
free oil, %	13%	9%	22%	22%	6%	9%
emusion, %	87.5%	90.6%	78.1%	78.1%	93.8%	90.6%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100%	100%	100%	100%	100%	100%
MP = Multiple Phase Emulsion	MP	MP	MP	MP	MP	MP
Static Age - 24 hrs at 150°F						
Total fluid height	32	32	32	32	32	32
free oil height	7	7	10	8	10	9
emusion height	25	25	22	24	22	23
free brine height	0	0	0	0	0	0
free oil, %	22%	22%	31%	25%	31%	28%
emusion, %	78.1%	78.1%	68.8%	75.0%	68.8%	71.9%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100%	100%	100%	100%	100%	100%
MP = Multiple Phase Emulsion	MP	MP	MP	MP	MP	MP
Difference (64 hrs/24 hrs at 150°F)						
free oil, %						
emusion, %						
free brine, %						

Sample #	279	280	281	282	283	284
Integrity Synvert IV (Lot# 000329), lb/bbl	5	5	5	5	2.5	2.5
Witco AX-180-2, lb/bbl	7.5	10	10	10	10	10
Witco DTA 350, lb/bbl dimer trimer			2	3		2
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50
Initial ES, volts @ 120°F	448	390	445	552	360	458
Hot-rolled 16 hrs, ES	398	431	345	288	359	229
Jar - S = Settling, 3 = 3 Phases, N = No	S	S	N	N	S	S
Initial Properties						
600 rpm at 120°F	26	24	30	47	24	32
300 rpm	14	13	18	33	13	19
200 rpm	9	9	13	28	9	15
100 rpm	5	5	9	21	5	10
6 rpm	1	1	3	9	2	3
3 rpm	1	1	3	6	1	2
Plastic Viscosity, cP	12	11	12	14	11	13
Yield Pt, lb/100ft^2	2	2	6	19	2	6
Gels, 10 sec/10 min.	1/2	1/2	3/4	6/6	1/2	3/3
Settling in thermocup	Y	Y	Y	N	Y	N

Sample #	279	280	281	282	283	284
HR 64 hrs at 150°F						
600 rpm at 120°F	25	25	32	56	25	35
300 rpm	13	13	20	42	13	22
200 rpm	9	9	16	36	9	13
100 rpm	5	5	11	28	5	12
6 rpm	1	1	4	15	1	4
3 rpm	1	1	3	8	1	4
Plastic Viscosity, cP	12	12	12	14	12	13
Yield Pt, lb/100ft^2	1	1	8	28	1	9
Gels, 10 sec/10 min.	1/1	1/1	4/5	7/5	2/2	5/3
Settling in Thermocup	Y	Y	Y	N	Y	N
Settling in Jar	1/4"	1/4"	-	1/4"	5/16"	-
API filt, ml total	3.0	3.2	2.0	2.1	2.1	2.2
API filt, ml oil	0.8	1.2	1.8	1.8	1.4	1.9
API filt, ml brine	2.2	2.0	0.2	0.2	0.7	0.3
HTHP at 150°F, ml	11.6	14.6	7.0	4.4	12.0	5.6
HTHP at 250°F, ml			15.0	12.4	20.8	14.8
Static Age - 64 hrs at 75°F						
Total fluid height	32	32	32	32	32	32
free oil height	3	8	9	10	9	9
emusion height	29	24	23	22	23	23
free brine height	0	0	0	0	0	0
free oil, %	9%	25%	28%	31%	28%	28%
emusion, %	90.6%	75.0%	71.9%	68.8%	71.9%	71.9%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100%	100%	100%	100%	100%	100%
MP = Multiple Phase Emulsion	MP	-	-	-	-	-
Static Age - 24 hrs at 150°F						
Total fluid height	32	32	32	32	32	32
free oil height	4	10	10	10	10	10
emusion height	28	22	22	22	22	22
free brine height	0	0	0	0	0	0
free oil, %	13%	31%	31%	31%	31%	31%
emusion, %	87.5%	68.8%	68.8%	68.8%	68.8%	68.8%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100%	100%	100%	100%	100%	100%
MP = Multiple Phase Emulsion	MP	-	-	-	-	-
Difference (64 hrs/24 hrs at 150°F)						
free oil, %						
emusion, %						
free brine, %						

Cesium formate, IA - 35 (50/50 mixture)

175 ml IA - 35 (0.828 sg) - (144.9 grams)
175 ml Cesium Formate (2.2 sg) - (385 grams)

NOTE: Make up 1/2 bbl Equivalents

Mixing Procedure:

1. Measure out IA - 35
1A. Add Synvis, mix 5 minutes
2. Add CsF, mix 10 min.
3. Add Synvert 5, mix 10 minutes
3A. Add calcium carbonate, mix 10 minutes
4. Run initial ES, viscosities at 120°F
5. Put 10 ml sample in a vial, SA for 24 hrs at 75°F, measure volumes
6. Hot-roll for 16 hours at 150°F
7. Remix, run rheology, ES, API, HTHP at 150°F
8. Put vials in oven and static-age at 150°F for 24 hrs, measure volumes
9. If 150°F HTHP is good, run at 250°F

NOTE: Make up 1/2 bbl Equivalents

NOTE: Make up 1/2 bbl Equivalents

oil/cs ratio	50/50		50/50	50/50		50/50	53/47
Sample #	**285**	**285**	**286**	**287**	**287**	**288**	**289**
IA - 35, grams	119.9	119.9	119.9	119.9	119.9	119.9	144.9
Cesium Formate, grams	385	385	385	385	385	385	385
Integrity Synvert 5, lb/bbl	25	25	25	25	25	25	25
Integrity Synvis, lb/bbl	5	5	5	10	10	10	5
Baroid Baracarb 50, lb/bbl	-	-	50	-	-	50	-
Initial ES, volts	823		680	646		595	641
Hot-rolled 16 hrs, ES	494		619	551		528	509
Initial Properties							
600 rpm at 120°F	273	164	300+	300+	300+	300+	142
300 rpm	184	94	230	300+	290	300+	85
200 rpm	144	67	182	300+	230	300+	64
100 rpm	102	39	130	229	157	300+	40
6 rpm	39	7	41	81	45	119	10
3 rpm	26	5	37	72	38	105	8
Plastic Viscosity, cP	89	70	-	-		-	57
Yield Pt, lb/100ft^2	95	24	-	-		-	28
Gels, 10 sec/10 min.	23/27	5/7	33/37	65/72	35/42	87/96	7/9
Settling in thermocup	N		N	N		N	N
API filt, ml total	10 (8 min)		0	1.5		0	10 (2 min)
API filt, ml oil	0		0	0		0	0
API filt, ml brine	0		0	0		0	0
HTHP at 150°F, ml							
HTHP at 250°F, ml							
HR 16 hrs at 150°F							
600 rpm at 120°F	270		294	300+		300+	197
300 rpm	171		184	300+		300+	120
200 rpm	132		148	300+		300+	90
100 rpm	89		100	300+		284	60
6 rpm	24		28	102		95	16
3 rpm	19		23	87		83	13
Plastic Viscosity, cP	99		110	-		-	77
Yield Pt, lb/100ft^2	72		74	-		-	43
Gels, 10 sec/10 min.	16/21		21/25	81/86		74/84	11/16
Comments							

oil/cs ratio	50/50		50/50	50/50		50/50	53/47
Sample #	**285**	**285**	**286**	**287**	**287**	**288**	**289**
24 hrs at 75°F							
Total fluid heighth	33		34	34		33	34
free oil heighth	0		0	0		0	0
emusion heighth	33		34	34		33	34
free brine heighth	0		0	0		0	0
free oil, %	0%		0%	0%		0%	0%
emusion, %	100.0%		100.0%	100.0%		100.0%	100.0%
free brine, %	0.0%		0.0%	0.0%		0.0%	0.0%
24 hrs at 150°F							
Total fluid heighth	33		34	34		33	34
free oil heighth	0		0	0		0	0
emusion heighth	33		34	34		33	34
free brine heighth	0		0	0		0	0
free oil, %	0%		0%	0%		0%	0%
emusion, %	100.0%		100.0%	100.0%		100.0%	100.0%
free brine, %	0.0%		0.0%	0.0%		0.0%	0.0%
72 hrs at 150°F							
Total fluid heighth	33		34	34		33	34
free oil heighth	1		2	0		0	2
emusion heighth	32		32	34		33	32
free brine heighth	0		0	0		0	0
free oil, %	3%		6%	0%		0%	6%
emusion, %	97.0%		94.1%	100.0%		100.0%	94.1%
free brine, %	0.0%		0.0%	0.0%		0.0%	0.0%
API filt, ml total							
API filt, ml oil							
API filt, ml brine							
HTHP at 150°F, ml							
HTHP at 250°F, ml							
HR 16 hrs at 150°F							
600 rpm at 120°F	292						200
300 rpm	192						124
200 rpm	151						94
100 rpm	102						59
6 rpm	31						14
3 rpm	25						11
Plastic Viscosity, cP	100						76
Yield Pt, lb/100ft^2	92						48
Gels, 10 sec/10 min.	23/26						10/12
Comments							

oil/cs ratio	53/47	48.5/51.5	48.5/51.5	48.5/51.5	48.5/51.5	56/44	56/44
Sample #	**290**	**291**	**292**	**293**	**294**	**295**	**296**
IA - 35, grams	144.9	94.9	94.9	94.9	94.9	144.9	144.9
Cesium Formate, grams	385	385	385	385	385	385	385
Integrity Synvert 5, lb/bbl	25	50	50	50	50	50	50
Integrity Synvis, lb/bbl	10	5	5	10	10	5	10
Baroid Baracarb 50, lb/bbl	-	-	50	-	50	-	-
Initial ES, volts	1032	452	392	409	337	651	698
Hot-rolled 16 hrs, ES	660	469	442	373	341	490	645
Initial Properties							
600 rpm at 120°F	300+	262	300+	300+	300+	114	300+
300 rpm	300+	164	193	300+	300+	68	230
200 rpm	287	129	149	300+	300+	50	184
100 rpm	243	86	100	300+	221	33	126
6 rpm	83	24	28	115	73	11	38
3 rpm	73	19	22	98	61	9	31
Plastic Viscosity, cP	-	98	-	-	-	46	-
Yield Pt, lb/100ft^2	-	66	-	-	-	22	-
Gels, 10 sec/10 min.	64/69	19/25	21/28	89/103	57/76	4/4	29/36
Settling in thermocup	N	N	N	N	N	N	N
API filt, ml total	1.5	10 (2 min)	0.0	7.0	0.0	6.9	10 (2 min)
API filt, ml oil	0	0	0	0	0	0	0
API filt, ml brine	0	0	0	0	0	0	0
HTHP at 150°F, ml							
HTHP at 250°F, ml							
HR 16 hrs at 150°F							
600 rpm at 120°F	300+	300+	300+	300+	300+	152	300+
300 rpm	300+	206	257	300+	300+	89	203
200 rpm	243	160	202	300+	300+	65	155
100 rpm	177	109	140	263	298	41	106
6 rpm	69	33	43	89	100	11	32
3 rpm	59	29	36	78	88	9	27
Plastic Viscosity, cP	-	-	-	-	-	63	-
Yield Pt, lb/100ft^2	-	-	-	-	-	26	-
Gels, 10 sec/10 min.	46/53	24/33	33/42	70/80	78/88	3/4	25/32
Comments							

oil/cs ratio	53/47	48.5/51.5	48.5/51.5	48.5/51.5	48.5/51.5	56/44	56/44
Sample #	**290**	**291**	**292**	**293**	**294**	**295**	**296**
24 hrs at 75°F							
Total fluid heighth	34	35	34	33	33	34	34
free oil heighth	0	0	0	0	0	0	0
emusion heighth	34	35	34	33	33	34	34
free brine heighth	0	0	0	0	0	0	0
free oil, %	0%	0%	0%	0%	0%	0%	0%
emusion, %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
24 hrs at 150°F							
Total fluid heighth	34	35	34	33	33	34	34
free oil heighth	0	0	1	0	0	1	0
emusion heighth	34	35	33	33	33	33	34
free brine heighth	0	0	0	0	0	0	0
free oil, %	0%	0%	3%	0%	0%	3%	0%
emusion, %	100.0%	100.0%	97.1%	100.0%	100.0%	97.1%	100.0%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
72 hrs at 150°F							
Total fluid heighth	34	35	34	33	33	34	34
free oil heighth	0	2	2	0	0	5	0
emusion heighth	34	33	32	33	33	29	34
free brine heighth	0	0	0	0	0	0	0
free oil, %	0%	6%	6%	0%	0%	15%	0%
emusion, %	100.0%	94.3%	94.1%	100.0%	100.0%	85.3%	100.0%
free brine, %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HR 16 hrs at 150°F							
600 rpm at 120°F		300+				144	
300 rpm		240				83	
200 rpm		189				61	
100 rpm		129				38	
6 rpm		41				9	
3 rpm		34				7	
Plastic Viscosity, cP		-				61	
Yield Pt, lb/100ft^2		-				22	
Gels, 10 sec/10 min.		32/38				7/9	
Comments							

Cesium formate, Escaid 110 (50/50 mixture)

175 ml Escaid 110 (0.803 sg) - (140.5 grams)
175 ml Cesium Formate (2.2 sg) - (385 grams)

Mixing Procedure:

1. Measure out Escaid 110
2. Add emulsifiers, mix 5 minutes, add Barablock, mix 10 minutes
3. Add CsF, mix 10 min. on HB, mix on Silverson to 135°F

3A. Add Lo-Wate, mix 10 min. on HB

4. Run initial ES, viscosities at 120°F
5. Put 10 ml sample in a vial, SA for 24 hrs at 75°F, measure volumes
6. Hot-roll for 16 hours at 150°F
7. Remix, run rheology, ES, API, HTHP at 150°F
8. Put vials in oven and static-age at 150°F for 24 hrs, measure volumes
9. If 150°F HTHP is good, run at 250°F

Sample #	261	262	263	264	265	266
Integrity Synvert IV (Lot# 000329), lb/bbl	10	15	20	15		
Rhodia Miranol CS, lb/bbl					7	10.5
Witco AX-180-2, lb/bbl						
Witco DTA 350, lb/bbl dimer trimer				3		
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50
Initial ES, volts	285	306	355	327	8	1
Hot-rolled 16 hrs, ES	320	350	314	376	2	1
Initial Properties						
600 rpm at 120°F	26	25	25	27	64	66
300 rpm	13	12	13	13	40	41
200 rpm	9	8	9	8	32	32
100 rpm	5	4	4	4	22	23
6 rpm	1	1	1	0	7	8
3 rpm	1	1	1	0	4	5
Plastic Viscosity, cP	13	13	12	14	24	25
Yield Pt, lb/100ft^2	0	-1	1	-1	16	16
Gels, 10 sec/10 min.	0/1	0/1	1/1	1/1	6/4	6/5
Settling in thermocup	yes	yes	yes	yes	no	no
API filt, ml total	4.8	4.1	2.7	2.7	11 (1 min)	10 (1 min)
API filt, ml oil	-	-	-	-	-	-
API filt, ml brine	-	-	-	-	4.2	7.0
HR 16 hrs at 150°F						
600 rpm at 120°F	26	26	27	42	63	54
300 rpm	14	13	14	25	40	34
200 rpm	9	8	9	20	31	28
100 rpm	5	5	5	14	19	20
6 rpm	1	1	1	3	6	6
3 rpm	1	1	1	3	4	3
Plastic Viscosity, cP	12	13	13	17	23	20
Yield Pt, lb/100ft^2	2	0	1	8	17	14
Gels, 10 sec/10 min.	1/1	1/1	1/1	1/1	4/5	5/4
Comments	settling	settling	settling	1/4 inch oil	3 phases	3 phases

Sample #	261	262	263	264	265	266
24 hrs at 75°F						
Total fluid heighth	32	33	33	32	32	32
free oil heighth	2	2	2	2	0	0
emusion heighth	28	29	29	30	21	21
free brine heighth	0	0	0	0	11	11
free oil, %	6%	6%	6%	6%	0%	0%
emusion, %	87.5%	87.9%	87.9%	93.8%	65.6%	65.6%
free brine, %	0.0%	0.0%	0.0%	0.0%	34.4%	34.4%
24 hrs at 150°F						
Total fluid heighth	32	33	33	32	32	32
free oil heighth	2	4	3	5	0	0
emusion heighth	30	29	30	27	21	20
free brine heighth	0	0	0	0	11	12
free oil, %	6%	12%	9%	16%	0%	0%
emusion, %	93.8%	87.9%	90.9%	84.4%	65.6%	62.5%
free brine, %	0.0%	0.0%	0.0%	0.0%	34.4%	37.5%
Difference (72 hrs/24 hrs at 150°F)						
free oil, %	0%	6%	3%	9%	0%	0%
emusion, %	6%	0%	3%	-9%	0%	-3%
free brine, %	0%	0%	0%	0%	0%	3%

Sample #	267	268	269	270	271	272
Integrity Synvert IV (Lot# 000329), lb/bbl						
Rhodia Miranol CS, lb/bbl	14	10.5				
Witco AX-180-2, lb/bbl			7	10.5	14	10.5
Witco DTA 350, lb/bbl dimer trimer		3				3
Baroid Baracarb 50, lb/bbl	50	50	50	50	50	50
Initial ES, volts	1	37	151	318	349	345
Hot-rolled 16 hrs, ES	0	18	175	351	419	321
Initial Properties						
600 rpm at 120°F	66	67	30	24	25	94
300 rpm	42	47	17	13	13	70
200 rpm	34	50	13	9	9	59
100 rpm	24	31	8	6	6	46
6 rpm	8	2	2	1	1	15
3 rpm	4	2	2	1	1	6
Plastic Viscosity, cP	24	20	13	11	12	24
Yield Pt, lb/100ft^2	18	27	4	2	1	46
Gels, 10 sec/10 min.	6/4	5/12	2/3	1/1	1/1	9/7
Settling in thermocup	no	no	no	yes	yes	no
API filt, ml total	10 (1 min)	1.9	2.6	1/1	0.9	0.4
API filt, ml oil	-	0.6	-	-	-	-
API filt, ml brine	2.5	0.3	-	-	-	-

Sample #	267	268	269	270	271	272
HR 16 hrs at 150°F						
600 rpm at 120°F	62	67	33	28	28	79
300 rpm	39	42	19	16	16	61
200 rpm	32	37	15	12	11	53
100 rpm	22	26	10	8	7	42
6 rpm	7	2	3	2	2	16
3 rpm	4	2	2	2	2	7
Plastic Viscosity, cP	23	25	14	12	12	18
Yield Pt, lb/100ft^2	16	17	5	4	4	43
Gels, 10 sec/10 min.	6/5	2/9	3/4	3/3	2/2	9/6
Comments	3 phases	2 phases	sagging	sagging	sagging	3/8 inch oil
24 hrs at 75°F						
Total fluid heighth	32	32	32	32	32	32
free oil heighth	0	12	4	4	4	5
emusion heighth	23	20	28	28	28	27
free brine heighth	9	0	0	0	0	0
free oil, %	0%	38%	13%	13%	13%	16%
emusion, %	71.9%	62.5%	87.5%	87.5%	87.5%	84.4%
free brine, %	28.1%	0.0%	0.0%	0.0%	0.0%	0.0%
24 hrs at 150°F						
Total fluid heighth	32	32	32	32	32	32
free oil heighth	0	12	7	5	5	12
emusion heighth	22	20	25	27	27	20
free brine heighth	10	0	0	0	0	0
free oil, %	0%	38%	22%	16%	16%	38%
emusion, %	68.8%	62.5%	78.1%	84.4%	84.4%	62.5%
free brine, %	31.3%	0.0%	0.0%	0.0%	0.0%	0.0%
Difference (72 hrs/24 hrs at 150°F)						
free oil, %	0%	0%	9%	3%	3%	22%
emusion, %	-3%	0%	-9%	-3%	-3%	-22%
free brine, %	3%	0%	0%	0%	0%	0%

Other embodiments of the present invention will be apparent to those skilled in the art from consideration of the present specification and practice of the present invention disclosed herein. It is intended that the present specification and examples be considered as exemplary only with a true scope and spirit of the invention being indicated by the following claims and equivalents thereof.